

# The intcalc package

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## Abstract

This package provides expandable arithmetic operations with integers.

## Contents

<b>1</b>	<b>Documentation</b>	<b>2</b>
1.1	Introduction	2
1.2	Conditions	2
1.2.1	Preconditions	2
1.2.2	Postconditions	3
1.3	Error handling	3
1.4	Operations	3
1.4.1	Num	3
1.4.2	Inv, Abs, Sgn	4
1.4.3	Min, Max, Cmp	4
1.4.4	Inc, Dec, Add, Sub	5
1.4.5	Shl, Shr	5
1.4.6	Mul, Sqr, Fac, Pow	5
1.4.7	Div, Mod	6
1.5	Interface for programmer	6
<b>2</b>	<b>Implementation</b>	<b>7</b>
2.1	Reload check and package identification	7
2.2	Catcodes	8
2.3	Macros independent of $\varepsilon$ -TeX	9
2.3.1	Abs, Sgn	9
2.3.2	Min, Max, Cmp	9
2.3.3	Fac	10
2.4	Implementation based on $\varepsilon$ -TeX	10
2.4.1	Num	10
2.4.2	Inv, Abs, Sgn	10
2.4.3	Min, Max, Cmp	11
2.4.4	Inc, Dec	11
2.4.5	Add, Sub	11
2.4.6	Shl, Shr	12
2.4.7	Mul, Sqr, Fac	12
2.4.8	Pow	13
2.4.9	Div, Mod	14
2.5	Implementation without $\varepsilon$ -TeX	16
2.5.1	Num	16
2.5.2	Inv, Abs, Sgn	17
2.5.3	Min, Max, Cmp	17
2.5.4	Inc, Dec	17
2.5.5	Add, Sub	19

2.5.6	Shl, Shr	27
2.5.7	\InCa@Tim	29
2.5.8	Mul	32
2.5.9	Sqr, Fac	33
2.5.10	Pow	34
2.5.11	Div	35
2.5.12	Mod	39
2.5.13	Help macros	40
<b>3</b>	<b>Test</b>	<b>41</b>
3.1	Catcode checks for loading	41
3.2	Macro tests	41
3.2.1	Preamble with test macro definitions	41
3.2.2	Time	45
3.2.3	Test 4: additional mod/div operations	46
3.2.4	Test sets	46
<b>4</b>	<b>Installation</b>	<b>55</b>
4.1	Download	55
4.2	Bundle installation	55
4.3	Package installation	55
4.4	Refresh file name databases	56
4.5	Some details for the interested	56
<b>5</b>	<b>History</b>	<b>56</b>
	[2007/09/09 v1.0]	56
	[2007/09/27 v1.1]	57
<b>6</b>	<b>Index</b>	<b>57</b>

# 1 Documentation

## 1.1 Introduction

Package `intcalc` defines arithmetic operations that deal with integers. Integers mean numbers in  $\text{\TeX}$ . The same restrictions apply, the range is limited to  $[-2147483647, 2147483647]$ .

The operations have the form of macros that take one or two integers as parameter and return the integer result. The macro name is a three letter operation name prefixed by the package name, e.g. `\intcalcAdd{10}{43}` returns 53.

The macros are fully expandable, exactly two expansion steps generate the result. Therefore the operations may be used nearly everywhere in  $\text{\TeX}$ , even inside `\number`, `\csname`, file names, or other expandable contexts.

The package contains two implementations of the operations. If  $\varepsilon\text{-}\text{\TeX}$  is detected then the macros are implemented using its features (`\numexpr`). Otherwise the slower implementation without  $\varepsilon\text{-}\text{\TeX}$ 's help is choosen.

## 1.2 Conditions

### 1.2.1 Preconditions

- Arguments can be anything that  $\text{\TeX}$  interprets as “number”. Examples: plain numbers, count or length register, macros that expands to a number.
- The arguments are limited to the range  $-2147483647$  until  $2147483647$ . These numbers belong to the range. Note that some operations have additional restrictions to the range.

- The argument may be expressions that `\numexpr` understands if  $\varepsilon$ -TeX is available.
- The resulting number must fit in the allowed range.

### 1.2.2 Postconditions

Additional properties of the macros apart from calculating a correct result (of course ☺):

- The macros are fully expandable. Thus they can be used inside `\edef`, `\csname`, after `\number`, for example.
- Furthermore exactly two expansion steps calculate the result.
- The number consists of one optional minus sign and one to ten digits. The first digit is larger than zero for numbers that consists of more than one digit.

In short, the number format is exactly the same as `\number` generates. And the tokens (minus sign, digits) have catcode 12 (other).

- Call by value is simulated. First the arguments are converted to numbers. Then these numbers are used in the calculations.

Remember that arguments may contain expensive macros or  $\varepsilon$ -TeX expressions. This strategy avoids multiple evaluations of such arguments.

## 1.3 Error handling

There are two kinds of errors if a precondition is violated: Some errors are detected by the macros, example: division by zero. In this cases an undefined control sequence is called and causes a TeX error message, example: `\IntCalcError:DivisionByZero`. The name of the control sequence contains the reason for the error. The TeX error may be ignored. Then the operation returns zero as result. Because the macros are supposed to work in expandible contexts. An traditional error message, however, is not expandable and would break these contexts.

If a number exceeds the range of -2147483647 until 2147483647, then TeX throws an error “Number too big” and recovers by using biggest allowed value. Example for the negative number -3000000000 is replaced by -2147483647.

## 1.4 Operations

Some definition equations below use the function `Int` that converts a real number to an integer. The number is truncated that means rounding to zero:

$$\text{Int}(x) := \begin{cases} \lfloor x \rfloor & \text{if } x \geq 0 \\ \lceil x \rceil & \text{otherwise} \end{cases}$$

### 1.4.1 Num

`\intcalcNum {⟨x⟩}`

Macro `\intcalcNum` converts its argument to a normalized integer number without unnecessary leading zeros or signs. The result matches the regular expression:

`0|-?[1-9][0-9]*`

### 1.4.2 Inv, Abs, Sgn

`\intcalcInv {⟨x⟩}`

Macro `\intcalcInv` switches the sign.

$$\text{Inv}(x) := -x$$

`\intcalcAbs {⟨x⟩}`

Macro `\intcalcAbs` returns the absolute value of integer  $\langle x \rangle$ .

$$\text{Abs}(x) := |x|$$

`\intcalcSgn {⟨x⟩}`

Macro `\intcalcSgn` encodes the sign of  $\langle x \rangle$  as number.

$$\text{Sgn}(x) := \begin{cases} -1 & \text{if } x < 0 \\ 0 & \text{if } x = 0 \\ 1 & \text{if } x > 0 \end{cases}$$

These return values can easily be distinguished by `\ifcase`:

```
\ifcase\intcalcSgn{<x>}
  $x=0$
\or
  $x>0$
\else
  $x<0$
\fi
```

### 1.4.3 Min, Max, Cmp

`\intcalcMin {⟨x⟩} {⟨y⟩}`

Macro `\intcalcMin` returns the smaller of the two integers.

$$\text{Min}(x, y) := \begin{cases} x & \text{if } x < y \\ y & \text{otherwise} \end{cases}$$

`\intcalcMax {⟨x⟩} {⟨y⟩}`

Macro `\intcalcMax` returns the larger of the two integers.

$$\text{Max}(x, y) := \begin{cases} x & \text{if } x > y \\ y & \text{otherwise} \end{cases}$$

`\intcalcCmp {⟨x⟩} {⟨y⟩}`

Macro `\intcalcCmp` encodes the comparison result as number:

$$\text{Cmp}(x, y) := \begin{cases} -1 & \text{if } x < y \\ 0 & \text{if } x = y \\ 1 & \text{if } x > y \end{cases}$$

These values can be distinguished by `\ifcase`:

```

\ifcase\intcalcCmp{<x>}{<y>}
  $x=y$
\or
  $x>y$
\else
  $x<y$
\fi

```

#### 1.4.4 Inc, Dec, Add, Sub

`\intcalcInc {<x>}`

Macro `\intcalcInc` increments  $\langle x \rangle$  by one.

$$\text{Inc}(x) := x + 1$$

`\intcalcDec {<x>}`

Macro `\intcalcDec` decrements  $\langle x \rangle$  by one.

$$\text{Dec}(x) := x - 1$$

`\intcalcAdd {<x>} {<y>}`

Macro `\intcalcAdd` adds the two numbers.

$$\text{Add}(x, y) := x + y$$

`\intcalcSub {<x>} {<y>}`

Macro `\intcalcSub` calculates the difference.

$$\text{Sub}(x, y) := x - y$$

#### 1.4.5 Shl, Shr

`\intcalcShl {<x>}`

Macro `\intcalcShl` implements shifting to the left that means the number is multiplied by two. Overflow is possible. The sign is preserved.

$$\text{Shl}(x) := x * 2$$

`\intcalcShr {<x>}`

Macro `\intcalcShr` implements shifting to the right. That is equivalent to an integer division by two. The sign is preserved.

$$\text{Shr}(x) := \text{Int}(x/2)$$

#### 1.4.6 Mul, Sqr, Fac, Pow

`\intcalcMul {<x>} {<y>}`

Macro `\intcalcMul` calculates the product of  $\langle x \rangle$  and  $\langle y \rangle$ .

$$\text{Mul}(x, y) := x * y$$

`\intcalcSqr {⟨x⟩}`

Macro `\intcalcSqr` returns the square product.

$$\text{Sqr}(x) := x^2$$

`\intcalcFac {⟨x⟩}`

Macro `\intcalcFac` returns the factorial of  $\langle x \rangle$ . Negative numbers are not permitted.

$$\text{Fac}(x) := x! \quad \text{for } x \geq 0$$

$$(0! = 1)$$

`\intcalcPow Mx My`

Macro `\intcalcPow` calculates the value of  $\langle x \rangle$  to the power of  $\langle y \rangle$ . The error “division by zero” is thrown if  $\langle x \rangle$  is zero and  $\langle y \rangle$  is negative. permitted:

$$\text{Pow}(x, y) := \text{Int}(x^y) \quad \text{for } x \neq 0 \text{ or } y \geq 0$$

$$(0^0 = 1)$$

#### 1.4.7 Div, Mul

`\intcalcDiv {⟨x⟩} {⟨y⟩}`

Macro `\intcalcDiv` performs an integer division. Argument  $\langle y \rangle$  must not be zero.

$$\text{Div}(x, y) := \text{Int}(x/y) \quad \text{for } y \neq 0$$

`\intcalcMod {⟨x⟩} {⟨y⟩}`

Macro `\intcalcMod` gets the remainder of the integer division. The sign follows the divisor  $\langle y \rangle$ . Argument  $\langle y \rangle$  must not be zero.

$$\text{Mod}(x, y) := x \% y \quad \text{for } y \neq 0$$

The result ranges:

$$-|y| < \text{Mod}(x, y) \leq 0 \quad \text{for } y < 0$$

$$0 \leq \text{Mod}(x, y) < y \quad \text{for } y \geq 0$$

### 1.5 Interface for programmer

If the programmer can ensure some more properties about the arguments of the operations, then the following macros are a little more efficient.

In general numbers must obey the following constraints:

- Plain number: digit tokens only, no command tokens.
- Non-negative. Signs are forbidden.
- Arguments and the result must fit in range 0..2147483647.
- Delimited by exclamation mark. Curly braces around the number are not allowed and will break the code.

`\IntCalcInc  $\langle number \rangle$  !`

Incrementation, range: 0..2147483646.

`\IntCalcDec  $\langle number \rangle$  !`

Decrementation, range: 1..2147483647.

`\IntCalcAdd  $\langle number A \rangle$  !  $\langle number B \rangle$  !`

Addition,  $A \geq B$ .

`\IntCalcSub  $\langle number A \rangle$  !  $\langle number B \rangle$  !`

Subtraction,  $A \geq B$ .

`\IntCalcShl  $\langle number \rangle$  !`

Left shift (multiplication with two), range: 0..1073741823.

`\IntCalcShr  $\langle number \rangle$  !`

Right shift (integer division by two).

`\IntCalcMul  $\langle number A \rangle$  !  $\langle number B \rangle$  !`

Multiplication,  $A \geq B$ .

`\IntCalcDiv  $\langle number A \rangle$  !  $\langle number B \rangle$  !`

Division operation.

`\IntCalcMod  $\langle number A \rangle$  !  $\langle number B \rangle$  !`

Modulo operation.

## 2 Implementation

1 `\*package`

### 2.1 Reload check and package identification

Reload check, especially if the package is not used with L<sup>A</sup>T<sub>E</sub>X.

```
2 \begingroup
3 \catcode44 12 % ,
4 \catcode45 12 % -
5 \catcode46 12 % .
6 \catcode58 12 % :
7 \catcode64 11 % @
8 \expandafter\let\expandafter\x\csname ver@intcalc.sty\endcsname
9 \ifcase 0%
10 \ifx\x\relax % plain
11 \else
12 \ifx\x\empty % LaTeX
13 \else
```

```

14      1%
15      \fi
16      \fi
17      \else
18      \expandafter\ifx\csname PackageInfo\endcsname\relax
19      \def\x#1#2{%
20      \immediate\write-1{Package #1 Info: #2.}%
21      }%
22      \else
23      \def\x#1#2{\PackageInfo{#1}{#2, stopped}}%
24      \fi
25      \x{intcalc}{The package is already loaded}%
26      \endgroup
27      \expandafter\endinput
28      \fi
29      \endgroup

```

Package identification:

```

30 \begingroup
31 \catcode40 12 % (
32 \catcode41 12 % )
33 \catcode44 12 % ,
34 \catcode45 12 % -
35 \catcode46 12 % .
36 \catcode47 12 % /
37 \catcode58 12 % :
38 \catcode64 11 % @
39 \expandafter\ifx\csname ProvidesPackage\endcsname\relax
40 \def\x#1#2#3[#4]{\endgroup
41 \immediate\write-1{Package: #3 #4}%
42 \xdef#1{#4}%
43 }%
44 \else
45 \def\x#1#2[#3]{\endgroup
46 #2[{#3}]%
47 \ifx#1\relax
48 \xdef#1{#3}%
49 \fi
50 }%
51 \fi
52 \expandafter\x\csname ver@intcalc.sty\endcsname
53 \ProvidesPackage{intcalc}%
54 [2007/09/27 v1.1 Expandable integer calculations (H0)]

```

## 2.2 Catcodes

```

55 \expandafter\edef\csname InCa@AtEnd\endcsname{%
56 \catcode64 \the\catcode64\relax
57 }
58 \catcode64 11 % @
59 \def\TMP@EnsureCode#1#2{%
60 \edef\InCa@AtEnd{%
61 \InCa@AtEnd
62 \catcode#1 \the\catcode#1\relax
63 }%
64 \catcode#1 #2\relax
65 }
66 \TMP@EnsureCode{33}{12}% !
67 \TMP@EnsureCode{40}{12}% (
68 \TMP@EnsureCode{41}{12}% )
69 \TMP@EnsureCode{42}{12}% *
70 \TMP@EnsureCode{43}{12}% +
71 \TMP@EnsureCode{45}{12}% -

```



```

72 \TMP@EnsureCode{47}{12}% /
73 \TMP@EnsureCode{58}{11}% : (letter!)
74 \TMP@EnsureCode{60}{12}% <
75 \TMP@EnsureCode{61}{12}% =
76 \TMP@EnsureCode{62}{12}% >
77 \TMP@EnsureCode{63}{14}% ? (comment!)
78 \begingroup\expandafter\expandafter\expandafter\endgroup
79 \expandafter\ifx\cename InCa@TestMode\endcsname\relax
80 \else
81   \catcode63=9 % ? (ignore)
82 \fi
83 ? \let\InCa@@TestMode\InCa@TestMode

```

## 2.3 Macros independent of $\varepsilon$ -TeX

### 2.3.1 Abs, Sgn

\InCa@Abs

```

84 \def\InCa@Abs#1#2!{%
85   \ifx#1-%
86     #2%
87   \else
88     #1#2%
89   \fi
90 }

```

\InCa@Sgn

```

91 \def\InCa@Sgn#1#2!{%
92   \ifx#1-%
93     -1%
94   \else
95     \ifx#10%
96       0%
97     \else
98       1%
99     \fi
100   \fi
101 }

```

### 2.3.2 Min, Max, Cmp

\InCa@Min

```

102 \def\InCa@Min#1!#2!{%
103   \ifnum#1<#2 %
104     #1%
105   \else
106     #2%
107   \fi
108 }

```

\InCa@Max

```

109 \def\InCa@Max#1!#2!{%
110   \ifnum#1>#2 %
111     #1%
112   \else
113     #2%
114   \fi
115 }

```

\InCa@Cmp

```

116 \def\InCa@Cmp#1!#2!{%
117   \ifnum#1=#2 %

```

```

118 0%
119 \else
120 \ifnum#1<#2 %
121 -%
122 \fi
123 1%
124 \fi
125 }

```

### 2.3.3 Fac

`\InCa@Fac` It does not make much sense to calculate the faculty by an general algorithm. The allowed range of arguments is too low because of the limited integer domain.

```

126 \def\InCa@Fac#1{%
127 \ifcase#1 1% 0!
128 \or 1% 1!
129 \or 2% 2!
130 \or 6% 3!
131 \or 24% 4!
132 \or 120% 5!
133 \or 720% 6!
134 \or 5040% 7!
135 \or 40320% 8!
136 \or 362880% 9!
137 \or 3628800% 10!
138 \or 39916800% 11!
139 \or 479001600% 12!
140 \else
141 \ifnum#1<\z@
142 0\IntCalcError:FacNegative%
143 \else
144 0\IntCalcError:FacOverflow%
145 \fi
146 \fi
147 }

```

## 2.4 Implementation based on $\varepsilon$ -TeX

Only `\numexpr` is used from  $\varepsilon$ -TeX.

```

148 \begingroup\expandafter\expandafter\expandafter\endgroup
149 \expandafter\ifx\csname numexpr\endcsname\relax
150 \else

```

### 2.4.1 Num

`\intcalcNum`

```

151 \def\intcalcNum#1{%
152 \the\numexpr#1\relax
153 }%

```

### 2.4.2 Inv, Abs, Sgn

`\intcalcInv`

```

154 \def\intcalcInv#1{%
155 \number-\intcalcNum{#1} %
156 }%

```

`\intcalcAbs`

```

157 \def\intcalcAbs#1{%
158 \number\expandafter\InCa@Abs\the\numexpr#1! %
159 }%

```

\intcalcSgn

```
160 \def\intcalcSgn#1{%
161   \number\expandafter\InCa@Sgn\the\numexpr#1! %
162 }%
```

### 2.4.3 Min, Max, Cmp

\intcalcMin

```
163 \def\intcalcMin#1#2{%
164   \number\expandafter\InCa@Min
165   \the\numexpr#1\expandafter!%
166   \the\numexpr#2! %
167 }%
```

\intcalcMax

```
168 \def\intcalcMax#1#2{%
169   \number\expandafter\InCa@Max
170   \the\numexpr#1\expandafter!%
171   \the\numexpr#2! %
172 }%
```

\intcalcCmp

```
173 \def\intcalcCmp#1#2{%
174   \number\expandafter\InCa@Cmp
175   \the\numexpr#1\expandafter!\the\numexpr#2! %
176 }%
```

### 2.4.4 Inc, Dec

\intcalcInc

```
177 \def\intcalcInc#1{%
178   \the\numexpr#1+1\relax
179 }%
```

\intcalcDec

```
180 \def\intcalcDec#1{%
181   \the\numexpr#1-1\relax
182 }%
```

\IntCalcInc

```
183 \def\IntCalcInc#1!{%
184   \the\numexpr#1+1\relax
185 }%
```

\IntCalcDec

```
186 \def\IntCalcDec#1!{%
187   \the\numexpr#1-1\relax
188 }%
```

### 2.4.5 Add, Sub

\intcalcAdd

```
189 \def\intcalcAdd#1#2{%
190   \the\numexpr#1+(#2)\relax
191 }%
```

\intcalcSub

```
192 \def\intcalcSub#1#2{%
193   \the\numexpr#1-(#2)\relax
194 }%
```

\IntCalcAdd

```
195 \def\IntCalcAdd#1!#2!{%
196   \the\numexpr#1+#2\relax
197 }%
```

\IntCalcSub

```
198 \def\IntCalcSub#1!#2!{%
199   \the\numexpr#1-#2\relax
200 }%
```

#### 2.4.6 Shl, Shr

\intcalcShl

```
201 \def\intcalcShl#1{%
202   \the\numexpr(#1)*2\relax
203 }%
```

\intcalcShr

```
204 \def\intcalcShr#1{%
205   \number\expandafter\InCa@Shr\the\numexpr#1! %
206 }%
```

\IntCalcShl

```
207 \def\IntCalcShl#1!{%
208   \the\numexpr#1*2\relax
209 }%
```

\IntCalcShr

```
210 \def\IntCalcShr#1!{%
211   \the\numexpr\ifodd#1 (#1-1)\else#1\fi/2\relax
212 }%
```

\InCa@Shr

```
213 \def\InCa@Shr#1#2!{%
214   \ifx#1-%
215     -\InCa@Shr#2!%
216   \else
217     \ifodd#1#2 %
218       \the\numexpr(#1#2-1)/2\relax
219     \else
220       \the\numexpr#1#2/2\relax
221     \fi
222   \fi
223 }%
```

#### 2.4.7 Mul, Sqr, Fac

\intcalcMul

```
224 \def\intcalcMul#1#2{%
225   \the\numexpr(#1)*(#2)\relax
226 }%
```

\IntCalcMul

```
227 \def\IntCalcMul#1!#2!{%
228   \the\numexpr#1*#2\relax
229 }%
```

\intcalcSqr

```
230 \def\intcalcSqr#1{%
231   \number\expandafter\InCa@Sqr\the\numexpr#1! %
232 }%
```

\InCa@Sqr

```
233 \def\InCa@Sqr#1!{%
234 \the\numexpr#1*#1\relax
235 }%
```

\intcalcFac

```
236 \def\intcalcFac#1{%
237 \number\expandafter\InCa@Fac\the\numexpr#1! %
238 }%
```

#### 2.4.8 Pow

\intcalcPow

```
239 \def\intcalcPow#1#2{%
240 \number\expandafter\InCa@Pow
241 \the\numexpr#1\expandafter!%
242 \the\numexpr#2! %
243 }%
```

\InCa@Pow

```
244 \def\InCa@Pow#1#2!#3#4!{%
245 \ifcase#3#4 % power = 0
246 1%
247 \or % power = 1
248 #1#2%
249 \or % power = 2
250 \the\numexpr#1#2*#1#2\relax
251 \else
252 \ifcase#1#2 % basis = 0, power <> 0
253 0%
254 \ifx#3-% power < 0
255 0\IntCalcError:DivisionByZero%
256 \fi
257 \or
258 1% basis = 1
259 \else
260 \ifnum#1#2=\m@ne % basis = -1
261 \ifodd#3#4 %
262 -%
263 \fi
264 1%
265 \else % |basis| > 1
266 \ifx#3-% power < 0
267 0%
268 \else % power > 2
269 \InCa@PowRec#1#2!#3#4!1!%
270 \fi
271 \fi
272 \fi
273 \fi
274 }%
```

\InCa@PowRec

```
Pow(b, p) {
  PowRec(b, p, 1)
}
PowRec(b, p, r) {
  if p == 1 then
    return r*b
  else
    ifodd p then
      return PowRec(b*b, (p-1)/2, r*b) % p div 2 = (p-1)/2
    else
```

```

        return PowRec(b*b, (p-1)/2, r)
    fi
  fi
}
275 \def\InCa@PowRec#1!#2!#3!{%
276   \ifnum#2=\@ne
277     \the\numexpr#1*#3\relax
278   \else
279     \ifodd#2 %
280       \expandafter\InCa@PowRec
281       \the\numexpr#1*#1\expandafter!%
282       \the\numexpr(#2-1)/2\expandafter!%
283       \the\numexpr#1*#3\expandafter\expandafter\expandafter!%
284     \else
285       \expandafter\InCa@PowRec
286       \the\numexpr#1*#1\expandafter!%
287       \the\numexpr(#2-1)/2\expandafter!%
288       \number#3\expandafter\expandafter\expandafter!%
289     \fi
290   \fi
291 }%

```

#### 2.4.9 Div, Mod

T<sub>E</sub>X's `\divide` truncates,  $\varepsilon$ -T<sub>E</sub>X's `\numexpr` rounds the result of a division. The rounding method is called “Symmetric Arithmetic Rounding” or “Round-Half-Up” (“Kaufmännisches Runden” in German):

$$\begin{aligned}
 1 &= 3 \text{ divide } 2 = 1.5 = \text{numexpr } 3/2 = 2 \\
 -1 &= -3 \text{ divide } 2 = -1.5 = \text{numexpr } -3/2 = -2
 \end{aligned}$$

Macro `\intcalcDiv` follows T<sub>E</sub>X and truncates. The calculation is done by the following formula:

$$\text{Div}(X, Y) = (X - (Y - 1)/2)/Y \quad \text{for } X, Y > 0 \quad (1)$$

The operator ‘/’ is `\numexpr`’s division.

```

\intcalcDiv
292 \def\intcalcDiv#1#2{%
293   \number\expandafter\InCa@Div
294   \the\numexpr#1\expandafter!%
295   \the\numexpr#2! %
296 }%

\InCa@Div
297 \def\InCa@Div#1!#2!{%
298   \ifcase#2 %
299     0\IntCalcError:DivisionByZero%
300   \else
301     \ifcase#1 %
302       0%
303     \else
304       \expandafter\InCa@@Div
305       \romannumeral 0%
306       \ifnum#1<\z@
307         \expandafter-\number-#1%
308       \else
309         \expandafter+\number#1%
310       \fi
311       \expandafter!%
312       \romannumeral 0%

```

```

313         \ifnum#2<\z@
314         \expandafter-\number-#2%
315     \else
316         \expandafter+\number#2%
317     \fi
318     !%
319 \fi
320 \fi
321 }%

\IntCalcDiv
322 \def\InCa@Temp#1{%
323     \def\IntCalcDiv##1!##2!{%
324         \number
325         \ifcase##2 %
326             0\IntCalcError:DivisionByZero%
327         \else
328             \ifcase##1 %
329                 0%
330             \else
331                 \the\numexpr(##1-(##2-1)/2)/##2\relax
332             \fi
333         \fi
334         #1%
335     }%
336 }%
337 \InCa@Temp{ }%

\InCa@@Div
338 \def\InCa@@Div#1#2!#3#4!{%
339     #1#3%
340     \the\numexpr(#2-(#4-1)/2)/#4\relax
341 }%

\intcalcMod
342 \def\intcalcMod#1#2{%
343     \number\expandafter\InCa@Mod
344     \the\numexpr#1\expandafter!%
345     \the\numexpr#2! %
346 }%

\InCa@Mod
347 \def\InCa@Mod#1!#2!{%
348     \ifcase#2 %
349         0\IntCalcError:DivisionByZero%
350     \else
351         \ifcase#1 %
352             0%
353         \else
354             \expandafter\InCa@@Mod
355             \romannumeral 0%
356             \ifnum#1<\z@
357                 \expandafter-\number-#1%
358             \else
359                 \expandafter+\number#1%
360             \fi
361             \expandafter!%
362             \romannumeral 0%
363             \ifnum#2<\z@
364                 \expandafter-\number-#2%
365             \else
366                 \expandafter+\number#2%

```

```

367         \fi
368         !%
369         \fi
370     \fi
371 }%

\IntCalcMod

372 \def\InCa@Temp#1{%
373     \def\IntCalcMod##1!##2!{%
374         \number
375         \ifcase##2 %
376             0\IntCalcError:DivisionByZero%
377         \else
378             \ifcase##1 %
379                 0%
380             \else
381                 \the\numexpr##1-(##1-(##2-1)/2)/##2*##2\relax
382             \fi
383         \fi
384         #1%
385     }%
386 }%
387 \InCa@Temp{ }%

\InCa@@Mod

388 \def\InCa@@Mod#1#2!#3#4!{%
389     \if#3+%
390         \if#1+%
391             \the\numexpr#2-\InCa@@Div+#2!+#4!*#4\relax
392         \else
393             \expandafter\InCa@ModX
394             \the\numexpr-#2+\InCa@@Div+#2!+#4!*#4!#4!%
395         \fi
396     \else
397         -%
398         \if#1+%
399             \expandafter\InCa@ModX
400             \the\numexpr-#2+\InCa@@Div+#2!+#4!*#4!#4!%
401         \else
402             \the\numexpr#2-\InCa@@Div+#2!+#4!*#4\relax
403         \fi
404     \fi
405 }%

\InCa@ModX

406 \def\InCa@ModX#1!#2!{%
407     \ifcase#1 %
408         0%
409     \else
410         \the\numexpr#1+#2\relax
411     \fi
412 }%

413 \InCa@AtEnd
414 \expandafter\endinput
415 \fi

```

## 2.5 Implementation without $\varepsilon$ -TeX

### 2.5.1 Num

```
\intcalcNum
```



```

416 \def\intcalcNum#1{%
417   \number\expandafter\InCa@FirstOfOne\number#1! %
418 }

```

### 2.5.2 Inv, Abs, Sgn

\intcalcInv

```

419 \def\intcalcInv#1{%
420   \number\expandafter\InCa@FirstOfOne\number-#1! %
421 }

```

\InCa@FirstOfOne

```

422 \def\InCa@FirstOfOne#1!{#1}

```

\intcalcAbs

```

423 \def\intcalcAbs#1{%
424   \number\expandafter\InCa@Abs\number#1! %
425 }

```

\intcalcSgn

```

426 \def\intcalcSgn#1{%
427   \number\expandafter\InCa@Sgn\number#1! %
428 }

```

### 2.5.3 Min, Max, Cmp

\intcalcMin

```

429 \def\intcalcMin#1#2{%
430   \number\expandafter\InCa@Min
431   \number\number#1\expandafter!\number#2! %
432 }

```

\intcalcMax

```

433 \def\intcalcMax#1#2{%
434   \number\expandafter\InCa@Max
435   \number\number#1\expandafter!\number#2! %
436 }

```

\intcalcCmp

```

437 \def\intcalcCmp#1#2{%
438   \number\expandafter\InCa@Cmp
439   \number\number#1\expandafter!\number#2! %
440 }%

```

### 2.5.4 Inc, Dec

\intcalcInc

```

441 \def\intcalcInc#1{%
442   \number\expandafter\InCa@IncSwitch\number#1! %
443 }

```

\InCa@IncSwitch

```

444 \def\InCa@IncSwitch#1#2!{%
445   \ifx#1-%
446     -%
447     \csname InCa@Empty%
448     \InCa@Dec#2!%
449   \else
450     \csname InCa@Empty%
451     \InCa@Inc#1#2!%

```

```

452 \fi
453 }

\intcalcDec

454 \def\intcalcDec#1{%
455 \number\expandafter\InCa@DecSwitch\number#1! %
456 }

\InCa@DecSwitch

457 \def\InCa@DecSwitch#1#2!{%
458 \ifx#1-%
459 -%
460 \csname InCa@Empty%
461 \expandafter\InCa@Inc#2!%
462 \else
463 \ifx#10%
464 -1%
465 \else
466 \csname InCa@Empty%
467 \InCa@Dec#1#2!%
468 \fi
469 \fi
470 }

\IntCalcInc

471 \def\IntCalcInc#1!{%
472 \number\csname InCa@Empty\InCa@Inc#1! %
473 }

\IntCalcDec

474 \def\IntCalcDec#1!{%
475 \number\csname InCa@Empty\InCa@Dec#1! %
476 }

\InCa@Inc

477 \def\InCa@Inc#1#2{%
478 \ifx#2!%
479 \csname InCa@IncDigit#1\endcsname1%
480 \else
481 \csname InCa@IncDigit#1%
482 \expandafter\InCa@Inc\expandafter#2%
483 \fi
484 }

\InCa@IncDigit[0-8]

485 \def\InCa@Temp#1#2{%
486 \expandafter\def\csname InCa@IncDigit#1\endcsname##1{%
487 \endcsname
488 0%
489 \ifcase##1 %
490 #1%
491 \else
492 #2%
493 \fi
494 }%
495 }

496 \InCa@Temp 01
497 \InCa@Temp 12
498 \InCa@Temp 23
499 \InCa@Temp 34
500 \InCa@Temp 45

```

```

501 \InCa@Temp 56
502 \InCa@Temp 67
503 \InCa@Temp 78
504 \InCa@Temp 89

```

\InCa@IncDigit9

```

505 \expandafter\def\csname InCa@IncDigit9\endcsname#1{%
506   \expandafter\endcsname
507   \ifcase#1 %
508     09%
509   \else
510     10%
511   \fi
512 }

```

\InCa@Dec

```

513 \def\InCa@Dec#1#2{%
514   \ifx#2!%
515     \csname InCa@DecDigit#1\endcsname1%
516   \else
517     \csname InCa@DecDigit#1%
518     \expandafter\InCa@Dec\expandafter#2%
519   \fi
520 }

```

\InCa@DecDigit[1-9]

```

521 \def\InCa@Temp#1#2{%
522   \expandafter\def\csname InCa@DecDigit#1\endcsname##1{%
523     \endcsname
524     0%
525     \ifcase##1 %
526       #1%
527     \else
528       #2%
529     \fi
530   }%
531 }
532 \InCa@Temp 98
533 \InCa@Temp 87
534 \InCa@Temp 76
535 \InCa@Temp 65
536 \InCa@Temp 54
537 \InCa@Temp 43
538 \InCa@Temp 32
539 \InCa@Temp 21
540 \InCa@Temp 10

```

\InCa@DecDigit0

```

541 \expandafter\def\csname InCa@DecDigit0\endcsname#1{%
542   \expandafter\endcsname
543   \ifcase#1 %
544     00%
545   \else
546     19%
547   \fi
548 }

```

### 2.5.5 Add, Sub

\intcalcAdd

```

549 \def\intcalcAdd#1#2{%

```

```

550 \number
551 \expandafter\InCa@AddSwitch
552 \number\number#1\expandafter!%
553 \number#2! %
554 }

```

\intcalSub

```

555 \def\intcalSub#1#2{%
556 \number
557 \expandafter\InCa@AddSwitch
558 \number\number#1\expandafter!%
559 \number-\number#2! %
560 }

```

\InCa@AddSwitch Decision table for \InCa@AddSwitch. The sign of negative numbers can be removed by a simple \@gobble instead of the more expensive \number-.

$x < 0$	$y < 0$	$x < y$	-	$\text{Add}(-x, -y)$
		else		$\text{Add}(-y, -x)$
	else	$-x > y$	-	$\text{Sub}(-x, y)$
		else	+	$\text{Sub}(y, -x)$
else	$y < 0$	$x > -y$	+	$\text{Sub}(x, -y)$
		else	-	$\text{Sub}(-y, x)$
	else	$x > y$	+	$\text{Add}(x, y)$
		else		$\text{Add}(y, x)$

```

561 \def\InCa@AddSwitch#1!#2!{%
562 \ifnum#1<\z@
563 \ifnum#2<\z@
564 -%
565 \ifnum#1<#2 %
566 \expandafter\InCa@Add\number-#1\expandafter!%
567 \@gobble#2!%
568 \else
569 \expandafter\InCa@Add\number-#2\expandafter!%
570 \@gobble#1!%
571 \fi
572 \else
573 \ifnum-#1>#2 %
574 -%
575 \expandafter\InCa@Sub\@gobble#1!#2!%
576 \else
577 \expandafter\InCa@Sub\number#2\expandafter!%
578 \@gobble#1!%
579 \fi
580 \fi
581 \else
582 \ifnum#2<\z@
583 \ifnum#1>-#2 %
584 \expandafter\InCa@Sub\number#1\expandafter!%
585 \@gobble#2!%
586 \else
587 -%
588 \expandafter\InCa@Sub\@gobble#2!#1!%
589 \fi
590 \else
591 \ifnum#1>#2 %
592 \InCa@Add#1!#2!%
593 \else
594 \InCa@Add#2!#1!%
595 \fi
596 \fi

```

```

597 \fi
598 }

\IntCalcAdd
599 \def\IntCalcAdd#1!#2!{%
600 \number\InCa@Add#1!#2! %
601 }

\IntCalcSub
602 \def\IntCalcSub#1!#2!{%
603 \number\InCa@Sub#1!#2! %
604 }

\InCa@Space
605 \begingroup
606 \def\x#1{\endgroup
607 \let\InCa@Space= #1%
608 }%
609 \x{ }

\InCa@Add
610 \def\InCa@Add#1!#2!{%
611 \ifcase#2 %
612 #1%
613 \else
614 \InCa@@Add#1!#2!00000000\InCa@Space
615 \fi
616 }

\InCa@Sub
617 \def\InCa@Sub#1!#2!{%
618 \ifnum#1=#2 %
619 0%
620 \else
621 \InCa@@Sub#1!#2!00000000\InCa@Space
622 \fi
623 }

\InCa@@Add
624 \def\InCa@@Add#1!#2#3!{%
625 \ifx\InCa@Empty#3\InCa@Empty
626 \@ReturnAfterElseFi{%
627 \InCa@@@Add!!#1!#2%
628 }%
629 \else
630 \@ReturnAfterFi{%
631 \InCa@@Add#1!#3!#2%
632 }%
633 \fi
634 }

\InCa@@@Sub
635 \def\InCa@@@Sub#1!#2#3!{%
636 \ifx\InCa@Empty#3\InCa@Empty
637 \@ReturnAfterElseFi{%
638 \InCa@@@Sub!!#1!#2%
639 }%
640 \else
641 \@ReturnAfterFi{%
642 \InCa@@@Sub#1!#3!#2%
643 }%

```

```

644 \fi
645 }

\InCa@@@Add

646 \def\InCa@@@Add#1!#2!#3#4!#5{%
647 \ifx\InCa@Empty#4\InCa@Empty
648 \csname InCa@Empty%
649 \@ReturnAfterElseFi{%
650 \InCa@ProcessAdd#1#3!#5#2%
651 }%
652 \else
653 \@ReturnAfterFi{%
654 \InCa@@@Add#1#3!#5#2!#4!%
655 }%
656 \fi
657 }

\InCa@@@Sub

658 \def\InCa@@@Sub#1!#2!#3#4!#5{%
659 \ifx\InCa@Empty#4\InCa@Empty
660 \csname @gobble%
661 \@ReturnAfterElseFi{%
662 \InCa@ProcessSub#1#3!#5#2%
663 }%
664 \else
665 \@ReturnAfterFi{%
666 \InCa@@@Sub#1#3!#5#2!#4!%
667 }%
668 \fi
669 }

\InCa@ProcessAdd

670 \def\InCa@ProcessAdd#1#2!#3#4{%
671 \ifx\InCa@Empty#2\InCa@Empty
672 \csname InCa@AddDigit#1\endcsname#3%
673 \romannumeral0#4%
674 \else
675 \csname InCa@AddDigit#1\csname InCa@DigitCarry#3%
676 \@ReturnAfterFi{%
677 \InCa@ProcessAdd#2!#4%
678 }%
679 \fi
680 }

\InCa@ProcessSub

681 \def\InCa@ProcessSub#1#2!#3#4{%
682 \ifx\InCa@Empty#2\InCa@Empty
683 \csname InCa@SubDigit#1\endcsname#3%
684 \romannumeral0#4%
685 \else
686 \csname InCa@SubDigit#1\csname InCa@DigitCarry#3%
687 \@ReturnAfterFi{%
688 \InCa@ProcessSub#2!#4%
689 }%
690 \fi
691 }

\InCa@DigitCarry[0-9]

692 \def\InCa@Temp#1#2{%
693 \expandafter\def\csname InCa@DigitCarry#1\endcsname##1{%
694 \ifcase##1 %

```

```

695     \endcsname#1%
696     \else
697     \endcsname#2%
698     \fi
699   }%
700 }
701 \InCa@Temp 01
702 \InCa@Temp 12
703 \InCa@Temp 23
704 \InCa@Temp 34
705 \InCa@Temp 45
706 \InCa@Temp 56
707 \InCa@Temp 67
708 \InCa@Temp 78
709 \InCa@Temp 89
710 \InCa@Temp 9{{10}}

```

\InCa@AddDigit0

```

711 \expandafter\def\csname InCa@AddDigit0\endcsname#1{%
712   \ifnum#1>9 %
713     \endcsname10%
714   \else
715     \endcsname0#1%
716   \fi
717 }

```

\InCa@AddDigit[1-9]

```

718 \def\InCa@Temp#1#2#3{%
719   \expandafter\def\csname InCa@AddDigit#1\endcsname##1{%
720     \ifnum##1>#2 %
721       \endcsname 1%
722     \else
723       \endcsname 0%
724     \fi
725     \ifcase##1 #1% 0
726     #3%
727     \else #1% 10
728     \fi
729   }%
730 }
731 \InCa@Temp 18{%
732   \or 2% 1
733   \or 3% 2
734   \or 4% 3
735   \or 5% 4
736   \or 6% 5
737   \or 7% 6
738   \or 8% 7
739   \or 9% 8
740   \or 0% 9
741 }%
742 \InCa@Temp 27{%
743   \or 3% 1
744   \or 4% 2
745   \or 5% 3
746   \or 6% 4
747   \or 7% 5
748   \or 8% 6
749   \or 9% 7
750   \or 0% 8
751   \or 1% 9
752 }%

```

```

753 \InCa@Temp 36{%
754 \or 4% 1
755 \or 5% 2
756 \or 6% 3
757 \or 7% 4
758 \or 8% 5
759 \or 9% 6
760 \or 0% 7
761 \or 1% 8
762 \or 2% 9
763 }%
764 \InCa@Temp 45{%
765 \or 5% 1
766 \or 6% 2
767 \or 7% 3
768 \or 8% 4
769 \or 9% 5
770 \or 0% 6
771 \or 1% 7
772 \or 2% 8
773 \or 3% 9
774 }%
775 \InCa@Temp 54{%
776 \or 6% 1
777 \or 7% 2
778 \or 8% 3
779 \or 9% 4
780 \or 0% 5
781 \or 1% 6
782 \or 2% 7
783 \or 3% 8
784 \or 4% 9
785 }%
786 \InCa@Temp 63{%
787 \or 7% 1
788 \or 8% 2
789 \or 9% 3
790 \or 0% 4
791 \or 1% 5
792 \or 2% 6
793 \or 3% 7
794 \or 4% 8
795 \or 5% 9
796 }%
797 \InCa@Temp 72{%
798 \or 8% 1
799 \or 9% 2
800 \or 0% 3
801 \or 1% 4
802 \or 2% 5
803 \or 3% 6
804 \or 4% 7
805 \or 5% 8
806 \or 6% 9
807 }%
808 \InCa@Temp 81{%
809 \or 9% 1
810 \or 0% 2
811 \or 1% 3
812 \or 2% 4
813 \or 3% 5
814 \or 4% 6

```



```

815 \or 5% 7
816 \or 6% 8
817 \or 7% 9
818 }%
819 \InCa@Temp 90{%
820 \or 0% 1
821 \or 1% 2
822 \or 2% 3
823 \or 3% 4
824 \or 4% 5
825 \or 5% 6
826 \or 6% 7
827 \or 7% 8
828 \or 8% 9
829 }%

```

\InCa@SubDigit[0-9]

```

830 \def\InCa@Temp#1#2{%
831 \expandafter\def\csname InCa@SubDigit#1\endcsname##1{%
832 \ifnum##1>#1 %
833 \endcsname 1%
834 \else
835 \endcsname 0%
836 \fi
837 \ifcase##1 #1% 0
838 #2%
839 \else #1% 10
840 \fi
841 }%
842 }
843 \InCa@Temp 0{%
844 \or 9% 1
845 \or 8% 2
846 \or 7% 3
847 \or 6% 4
848 \or 5% 5
849 \or 4% 6
850 \or 3% 7
851 \or 2% 8
852 \or 1% 9
853 }
854 \InCa@Temp 1{%
855 \or 0% 1
856 \or 9% 2
857 \or 8% 3
858 \or 7% 4
859 \or 6% 5
860 \or 5% 6
861 \or 4% 7
862 \or 3% 8
863 \or 2% 9
864 }
865 \InCa@Temp 2{%
866 \or 1% 1
867 \or 0% 2
868 \or 9% 3
869 \or 8% 4
870 \or 7% 5
871 \or 6% 6
872 \or 5% 7
873 \or 4% 8
874 \or 3% 9
875 }

```

```

876 \InCa@Temp 3{%
877 \or 2% 1
878 \or 1% 2
879 \or 0% 3
880 \or 9% 4
881 \or 8% 5
882 \or 7% 6
883 \or 6% 7
884 \or 5% 8
885 \or 4% 9
886 }
887 \InCa@Temp 4{%
888 \or 3% 1
889 \or 2% 2
890 \or 1% 3
891 \or 0% 4
892 \or 9% 5
893 \or 8% 6
894 \or 7% 7
895 \or 6% 8
896 \or 5% 9
897 }
898 \InCa@Temp 5{%
899 \or 4% 1
900 \or 3% 2
901 \or 2% 3
902 \or 1% 4
903 \or 0% 5
904 \or 9% 6
905 \or 8% 7
906 \or 7% 8
907 \or 6% 9
908 }
909 \InCa@Temp 6{%
910 \or 5% 1
911 \or 4% 2
912 \or 3% 3
913 \or 2% 4
914 \or 1% 5
915 \or 0% 6
916 \or 9% 7
917 \or 8% 8
918 \or 7% 9
919 }
920 \InCa@Temp 7{%
921 \or 6% 1
922 \or 5% 2
923 \or 4% 3
924 \or 3% 4
925 \or 2% 5
926 \or 1% 6
927 \or 0% 7
928 \or 9% 8
929 \or 8% 9
930 }
931 \InCa@Temp 8{%
932 \or 7% 1
933 \or 6% 2
934 \or 5% 3
935 \or 4% 4
936 \or 3% 5
937 \or 2% 6

```

```

938 \or 1% 7
939 \or 0% 8
940 \or 9% 9
941 }
942 \InCa@Temp 9{%
943 \or 8% 1
944 \or 7% 2
945 \or 6% 3
946 \or 5% 4
947 \or 4% 5
948 \or 3% 6
949 \or 2% 7
950 \or 1% 8
951 \or 0% 9
952 }

```

### 2.5.6 Shl, Shr

\intcalcShl

```

953 \def\intcalcShl#1{%
954 \number\expandafter\InCa@ShlSwitch\number#1! %
955 }

```

\InCa@ShlSwitch

```

956 \def\InCa@ShlSwitch#1#2!{%
957 \ifx#1-%
958 -\csname InCa@Empty%
959 \InCa@Shl#2!%
960 \else
961 \csname InCa@Empty%
962 \InCa@Shl#1#2!%
963 \fi
964 }

```

\IntCalcShl

```

965 \def\IntCalcShl#1!{%
966 \number
967 \csname InCa@Empty%
968 \InCa@Shl#1! %
969 }

```

\IntCal@ShlDigit

```

970 \def\InCa@Shl#1#2{%
971 \ifx#2!%
972 \csname InCa@ShlDigit#1\endcsname0%
973 \else
974 \csname InCa@ShlDigit#1%
975 \@ReturnAfterFi{%
976 \InCa@Shl#2%
977 }%
978 \fi
979 }

```

\InCa@ShlDigit0

```

980 \expandafter\def\csname InCa@ShlDigit0\endcsname{%
981 \endcsname0%
982 }

```

\InCa@ShlDigit[1-9]

```

983 \def\InCa@Temp#1#2#3#4#5{%
984 \expandafter\def\csname InCa@ShlDigit#1\endcsname##1{%

```

```

985     \expandafter\endcsname
986     \ifcase##1 %
987         #2#3%
988     \else
989         #4#5%
990     \fi
991 }%
992 }
993 \InCa@Temp 10203
994 \InCa@Temp 20405
995 \InCa@Temp 30607
996 \InCa@Temp 40809
997 \InCa@Temp 51011
998 \InCa@Temp 61213
999 \InCa@Temp 71415
1000 \InCa@Temp 81617
1001 \InCa@Temp 91819

\intcalcShr

1002 \def\intcalcShr#1{%
1003     \number\expandafter\InCa@ShrSwitch\number#1! %
1004 }

\InCa@ShrSwitch

1005 \def\InCa@ShrSwitch#1#2!{%
1006     \ifx#1-%
1007         -\InCa@Shr#2!%
1008     \else
1009         \InCa@Shr#1#2!%
1010     \fi
1011 }

\IntCalcShr

1012 \def\IntCalcShr#1!{%
1013     \number\InCa@Shr#1! %
1014 }

\InCa@Shr

1015 \def\InCa@Shr#1#2{%
1016     \InCa@ShrDigit#1!%
1017     \ifx#2!%
1018     \else
1019         \@ReturnAfterFi{%
1020             \ifodd#1 %
1021                 \@ReturnAfterElseFi{%
1022                     \InCa@Shr{1#2}%
1023                 }%
1024             \else
1025                 \expandafter\InCa@Shr\expandafter#2%
1026             \fi
1027         }%
1028     \fi
1029 }

1030 \def\InCa@ShrDigit#1!{%
1031     \ifcase#1 0% 0
1032     \or 0% 1
1033     \or 1% 2
1034     \or 1% 3
1035     \or 2% 4
1036     \or 2% 5
1037     \or 3% 6

```

```

1038 \or 3% 7
1039 \or 4% 8
1040 \or 4% 9
1041 \or 5% 10
1042 \or 5% 11
1043 \or 6% 12
1044 \or 6% 13
1045 \or 7% 14
1046 \or 7% 15
1047 \or 8% 16
1048 \or 8% 17
1049 \or 9% 18
1050 \or 9% 19
1051 \fi
1052 }

```

### 2.5.7 \InCa@Tim

\InCa@Tim Macro \InCa@Tim implements “Number *times* digit”.

```

1053 \def\InCa@Temp#1{%
1054   \def\InCa@Tim##1##2{%
1055     \number
1056     \ifcase##2 % 0
1057       0%
1058     \or % 1
1059       ##1%
1060     \else % 2-9
1061       \csname InCa@Empty%
1062         \InCa@ProcessTim##2##1!%
1063     \fi
1064     #1%
1065   }%
1066 }
1067 \InCa@Temp{ }

```

\InCa@ProcessTim

```

1068 \def\InCa@ProcessTim#1#2#3{%
1069   \ifx#3!%
1070     \csname InCa@TimDigit#2\endcsname#10%
1071   \else
1072     \csname InCa@TimDigit#2\csname InCa@Param#1%
1073     \@ReturnAfterFi{%
1074       \InCa@ProcessTim#1#3%
1075     }%
1076   \fi
1077 }

```

\InCa@Param[0-9]

```

1078 \def\InCa@Temp#1{%
1079   \expandafter\def\csname InCa@Param#1\endcsname{%
1080     \endcsname#1%
1081   }%
1082 }
1083 \InCa@Temp 0%
1084 \InCa@Temp 1%
1085 \InCa@Temp 2%
1086 \InCa@Temp 3%
1087 \InCa@Temp 4%
1088 \InCa@Temp 5%
1089 \InCa@Temp 6%
1090 \InCa@Temp 7%
1091 \InCa@Temp 8%

```

```

1092 \InCa@Temp 9%

\InCa@TimDigit0
1093 \expandafter\def\csname InCa@TimDigit0\endcsname#1#2{%
1094 \endcsname
1095 0#2%
1096 }

\InCa@TimDigit1
1097 \expandafter\def\csname InCa@TimDigit1\endcsname#1#2{%
1098 \ifcase#2 %
1099 \endcsname 0#1%
1100 \else
1101 \csname InCa@AddDigit#1\endcsname #2%
1102 \fi
1103 }

\InCa@TimDigit[2-9]
1104 \def\InCa@Temp#1#2{%
1105 \expandafter\def\csname InCa@TimDigit#1\endcsname##1{%
1106 \expandafter\InCa@TimDigitCarry
1107 \number
1108 \ifcase##1 0% 0
1109 #2%
1110 \fi
1111 !%
1112 }%
1113 }
1114 \InCa@Temp 2{%
1115 \or 2% 1
1116 \or 4% 2
1117 \or 6% 3
1118 \or 8% 4
1119 \or 10% 5
1120 \or 12% 6
1121 \or 14% 7
1122 \or 16% 8
1123 \or 18% 9
1124 }
1125 \InCa@Temp 3{%
1126 \or 3% 1
1127 \or 6% 2
1128 \or 9% 3
1129 \or 12% 4
1130 \or 15% 5
1131 \or 18% 6
1132 \or 21% 7
1133 \or 24% 8
1134 \or 27% 9
1135 }
1136 \InCa@Temp 4{%
1137 \or 4% 1
1138 \or 8% 2
1139 \or 12% 3
1140 \or 16% 4
1141 \or 20% 5
1142 \or 24% 6
1143 \or 28% 7
1144 \or 32% 8
1145 \or 36% 9
1146 }
1147 \InCa@Temp 5{%

```

```

1148 \or 5% 1
1149 \or 10% 2
1150 \or 15% 3
1151 \or 20% 4
1152 \or 25% 5
1153 \or 30% 6
1154 \or 35% 7
1155 \or 40% 8
1156 \or 45% 9
1157 }
1158 \InCa@Temp 6{%
1159 \or 6% 1
1160 \or 12% 2
1161 \or 18% 3
1162 \or 24% 4
1163 \or 30% 5
1164 \or 36% 6
1165 \or 42% 7
1166 \or 48% 8
1167 \or 54% 9
1168 }
1169 \InCa@Temp 7{%
1170 \or 7% 1
1171 \or 14% 2
1172 \or 21% 3
1173 \or 28% 4
1174 \or 35% 5
1175 \or 42% 6
1176 \or 49% 7
1177 \or 56% 8
1178 \or 63% 9
1179 }
1180 \InCa@Temp 8{%
1181 \or 8% 1
1182 \or 16% 2
1183 \or 24% 3
1184 \or 32% 4
1185 \or 40% 5
1186 \or 48% 6
1187 \or 56% 7
1188 \or 64% 8
1189 \or 72% 9
1190 }
1191 \InCa@Temp 9{%
1192 \or 9% 1
1193 \or 18% 2
1194 \or 27% 3
1195 \or 36% 4
1196 \or 45% 5
1197 \or 54% 6
1198 \or 63% 7
1199 \or 72% 8
1200 \or 81% 9
1201 }

```

\InCa@TimDigitCarry

```

1202 \def\InCa@TimDigitCarry#1!{%
1203 \ifnum#1<10 %
1204 \csname InCa@AddDigit#1\expandafter\endcsname
1205 \else
1206 \@ReturnAfterFi{%
1207 \InCa@@TimDigitCarry#1!%
1208 }%

```

```

1209 \fi
1210 }

```

\InCa@@TimDigitCarry

```

1211 \def\InCa@@TimDigitCarry#1#2!#3{%
1212 \csname InCa@DigitCarry#1%
1213 \csname InCa@AddDigit#2\endcsname #3%
1214 }

```

### 2.5.8 Mul

\intcalcMul

```

1215 \def\intcalcMul#1#2{%
1216 \number
1217 \expandafter\InCa@MulSwitch
1218 \number\number#1\expandafter!%
1219 \number#2! %
1220 }

```

\InCa@MulSwitch Decision table for \InCa@MulSwitch.

$x < 0$	$y < 0$	$x < y$	+	$Mul(-x, -y)$
		else		$Mul(-y, -x)$
	else	$-x > y$	-	$Mul(-x, y)$
		else		$Mul(y, -x)$
else	$y < 0$	$x > -y$	-	$Mul(x, -y)$
		else		$Mul(-y, x)$
	else	$x > y$	+	$Mul(x, y)$
		else		$Mul(y, x)$

```

1221 \def\InCa@MulSwitch#1!#2!{%
1222 \ifnum#1<\z@
1223 \ifnum#2<\z@
1224 \ifnum#1<#2 %
1225 \expandafter\InCa@Mul\number-#1\expandafter!%
1226 \@gobble#2!%
1227 \else
1228 \expandafter\InCa@Mul\number-#2\expandafter!%
1229 \@gobble#1!%
1230 \fi
1231 \else
1232 -%
1233 \ifnum-#1>#2 %
1234 \expandafter\InCa@Mul\@gobble#1!#2!%
1235 \else
1236 \expandafter\InCa@Mul\number#2\expandafter!%
1237 \@gobble#1!%
1238 \fi
1239 \fi
1240 \else
1241 \ifnum#2<\z@
1242 -%
1243 \ifnum#1>-#2 %
1244 \expandafter\InCa@Mul\number#1\expandafter!%
1245 \@gobble#2!%
1246 \else
1247 \expandafter\InCa@Mul\@gobble#2!#1!%
1248 \fi
1249 \else
1250 \ifnum#1>#2 %
1251 \InCa@Mul#1!#2!%

```



```

1252         \else
1253         \InCa@Mul#2!#1!%
1254     \fi
1255 \fi
1256 \fi
1257 }

\IntCalcMul

1258 \def\IntCalcMul#1!#2!{%
1259     \number\InCa@Mul#1!#2! %
1260 }

\InCa@Mul

1261 \def\InCa@Mul#1!#2!{%
1262     \ifcase#2 %
1263         0%
1264     \or
1265         #1%
1266     \or
1267         \csname InCa@Empty%
1268         \expandafter\InCa@Shl#1!%
1269     \else
1270         \ifnum#2<10 %
1271             \InCa@Tim{#1}#2%
1272         \else
1273             \InCa@ProcessMul!#2!#1!%
1274         \fi
1275     \fi
1276 }

\InCa@Mul

1277 \def\InCa@ProcessMul#1!#2#3!#4!{%
1278     \ifx\InCa@Empty#3\InCa@Empty
1279         \expandafter\InCa@Add\number
1280         #10\expandafter\expandafter\expandafter!%
1281         \InCa@Tim{#4}#2!%
1282     \else
1283         \ifx\InCa@Empty#1\InCa@Empty
1284             \expandafter\expandafter\expandafter\InCa@ProcessMul
1285             \InCa@Tim{#4}#2!%
1286             #3!#4!%
1287         \else
1288             \expandafter\InCa@ProcessMul\number
1289             \expandafter\InCa@Add\number%
1290             #10\expandafter\expandafter\expandafter!%
1291             \InCa@Tim{#4}#2!%
1292             #3!#4!%
1293         \fi
1294     \fi
1295 }

```

### 2.5.9 Sqr, Fac

```

\intcalcSqr

1296 \def\intcalcSqr#1{%
1297     \number\expandafter\InCa@Sqr\number#1! %
1298 }

\InCa@Sqr

1299 \def\InCa@Sqr#1#2!{%
1300     \ifx#1-%

```

```

1301     \InCa@Mul#2!#2!%
1302 \else
1303     \InCa@Mul#1#2!#1#2!%
1304 \fi
1305 }

```

\intcalcFac

```

1306 \def\intcalcFac#1{%
1307     \number\expandafter\InCa@Fac\number#1! %
1308 }

```

## 2.5.10 Pow

\intcalcPow

```

1309 \def\intcalcPow#1#2{%
1310     \number\expandafter\InCa@Pow
1311     \number\number#1\expandafter!%
1312     \number#2! %
1313 }

```

\InCa@Pow

```

1314 \def\InCa@Pow#1#2!#3#4!{%
1315     \ifcase#3#4 % power = 0
1316     1%
1317 \or % power = 1
1318     #1#2%
1319 \or % power = 2
1320     \ifx#1-%
1321         \InCa@Mul#2!#2!%
1322     \else
1323         \InCa@Mul#1#2!#1#2!%
1324     \fi
1325 \else
1326     \ifcase#1#2 % basis = 0, power <> 0
1327     0%
1328     \ifx#3-% power < 0
1329         0\IntCalcError:DivisionByZero%
1330     \fi
1331 \or
1332     1% basis = 1
1333 \else
1334     \ifnum#1#2=\m@ne % basis = -1
1335         \ifodd#3#4 %
1336             -%
1337         \fi
1338         1%
1339     \else % |basis| > 1
1340         \ifx#3-% power < 0
1341             0%
1342         \else % power > 2
1343             \ifx#1-% basis < 0
1344                 \ifodd#3#4 %
1345                     -%
1346                 \fi
1347                 \InCa@PowRec#2!#3#4!1!%
1348             \else
1349                 \InCa@PowRec#1#2!#3#4!1!%
1350             \fi
1351         \fi
1352     \fi
1353 \fi
1354 }

```

```

1355 }

\InCa@PowRec      Pow(b, p) {
                  PowRec(b, p, 1)
                  }
                  PowRec(b, p, r) {
                    if p == 1 then
                      return r
                    else
                      ifodd p then
                        return PowRec(b*b, p div 2, r*b) % p div 2 = (p-1)/2
                      else
                        return PowRec(b*b, p div 2, r)
                      fi
                    fi
                  }

1356 \def\InCa@PowRec#1!#2!#3!{%
1357   \ifnum#2=\@one
1358     \ifnum#1>#3 %
1359       \InCa@Mul#1!#3!%
1360     \else
1361       \InCa@Mul#3!#1!%
1362     \fi
1363   \else
1364     \expandafter\InCa@PowRec
1365     \number\InCa@Mul#1!#1!\expandafter!%
1366     \number\intcalcShr{#2}\expandafter!%
1367     \number
1368     \ifodd#2 %
1369       \ifnum#1>#3 %
1370         \InCa@Mul#1!#3!%
1371       \else
1372         \InCa@Mul#3!#1!%
1373       \fi
1374     \else
1375       #3%
1376     \fi
1377     \expandafter!%
1378   \fi
1379 }

```

### 2.5.11 Div

```

\intcalcDiv

1380 \def\intcalcDiv#1#2{%
1381   \number\expandafter\InCa@Div
1382   \number\number#1\expandafter!%
1383   \number#2! %
1384 }

\InCa@Div

1385 \def\InCa@Div#1!#2!{%
1386   \ifcase#2 %
1387     0\IntCalcError:DivisionByZero%
1388   \else
1389     \ifcase#1 %
1390       0%
1391     \else
1392       \expandafter\InCa@DivSwitch
1393       \number#1\expandafter!%
1394       \number#2!%
1395     \fi

```

```

1396 \fi
1397 }

\IntCalcDiv

1398 \def\InCa@Temp#1{%
1399 \def\IntCalcDiv##1!##2!{%
1400 \number
1401 \ifcase##2 %
1402 0\IntCalcError:DivisionByZero%
1403 \else
1404 \ifcase##1 %
1405 0%
1406 \else
1407 \InCa@@Div##1!##2!%
1408 \fi
1409 \fi
1410 #1%
1411 }%
1412 }
1413 \InCa@Temp{ }%

```

\InCa@DivSwitch Decision table for \InCa@DivSwitch.

$x < 0$	$y < 0$	+	$\text{Div}(-x, -y)$
	else	-	$\text{Div}(-x, y)$
else	$y < 0$	-	$\text{Div}(x, -y)$
	else	+	$\text{Div}(x, y)$

```

1414 \def\InCa@DivSwitch#1!#2!{%
1415 \ifnum#1<\z@
1416 \ifnum#2<\z@
1417 \expandafter\InCa@@Div\number-#1\expandafter!%
1418 \@gobble#2!%
1419 \else
1420 -%
1421 \expandafter\InCa@@Div\@gobble#1!#2!%
1422 \fi
1423 \else
1424 \ifnum#2<\z@
1425 -%
1426 \expandafter\InCa@@Div\number#1\expandafter!%
1427 \@gobble#2!%
1428 \else
1429 \InCa@@Div#1!#2!%
1430 \fi
1431 \fi
1432 }

```

\InCa@@Div

```

1433 \def\InCa@@Div#1!#2!{%
1434 \ifnum#1>#2 %
1435 \ifcase#2 % 0 already caught
1436 ? \IntCalcError:ThisCannotHappen%
1437 \or % 1
1438 #1%
1439 \or % 2
1440 \InCa@Shr#1!%
1441 \else
1442 \InCa@DivStart!#1!#2!#2!%
1443 \fi
1444 \else
1445 \ifnum#1=#2 %

```

```

1446      1%
1447      \else
1448      0%
1449      \fi
1450      \fi
1451  }

\InCa@DivStart

1452  \def\InCa@DivStart#1!#2#3!#4#5{%
1453    \ifx#5!%
1454      \@ReturnAfterElseFi{%
1455        \InCa@DivStartI{#1#2}#3=!%
1456      }%
1457    \else
1458      \@ReturnAfterFi{%
1459        \InCa@DivStart{#1#2}!#3!#5%
1460      }%
1461    \fi
1462  }

\InCa@StartI

1463  \def\InCa@DivStartI#1!#2!{%
1464    \expandafter\InCa@DivStartII
1465    \number#2\expandafter\expandafter\expandafter!%
1466    \intcalcShl{#2}!%
1467    #1!%
1468  }

\InCa@StartII

1469  \def\InCa@DivStartII#1!#2!{%
1470    \expandafter\InCa@DivStartIII
1471    \number#1\expandafter!%
1472    \number#2\expandafter\expandafter\expandafter!%
1473    \intcalcShl{#2}!%
1474  }

\InCa@StartIII

1475  \def\InCa@DivStartIII#1!#2!#3!{%
1476    \expandafter\InCa@DivStartIV
1477    \number#1\expandafter!%
1478    \number#2\expandafter!%
1479    \number#3\expandafter!%
1480    \number\InCa@Add#3!#2!\expandafter\expandafter\expandafter!%
1481    \intcalcShl{#3}!%
1482  }

\InCa@StartIV

1483  \def\InCa@DivStartIV#1!#2!#3!#4!#5!#6!{%
1484    \InCa@ProcessDiv#6!#1!#2!#3!#4!#5!/%
1485  }

\InCa@ProcessDiv

1486  \def\InCa@ProcessDiv#1#2#3!#4!#5!#6!#7!#8!#9/{%
1487    #9%
1488    \ifnum#1<#4 % 0
1489      0%
1490      \ifx#2=%
1491        \else
1492          \InCa@ProcessDiv{#1#2}#3!#4!#5!#6!#7!#8!%
1493        \fi
1494      \else % 1-9

```

```

1495 \ifnum#1<#5 % 1
1496 1%
1497 \ifx#2=%
1498 \else
1499 \expandafter\InCa@ProcessDiv\expandafter{%
1500 \number\InCa@Sub#1!#4!%
1501 #2%
1502 }#3!#4!#5!#6!#7!#8!%
1503 \fi
1504 \else % 2-9
1505 \ifnum#1<#7 % 2 3 4 5
1506 \ifnum#1<#6 % 2 3
1507 \@ReturnAfterElseFi{%
1508 \expandafter\InCa@ProcessDiv
1509 \number\InCa@Sub#1!#5!!%
1510 23%
1511 }%
1512 \else % 4 5
1513 \@ReturnAfterFi{%
1514 \expandafter\InCa@ProcessDiv
1515 \number\InCa@Sub#1!#6!!%
1516 45%
1517 }%
1518 \fi
1519 #2#3!#4!#5!#6!#7!#8!%
1520 \else % 6 7 8 9
1521 \ifnum#1<#8 % 6 7
1522 \@ReturnAfterElseFi{%
1523 \expandafter\InCa@ProcessDiv
1524 \number\InCa@Sub#1!#7!!%
1525 67%
1526 }%
1527 \else % 8 9
1528 \@ReturnAfterFi{%
1529 \expandafter\InCa@ProcessDiv
1530 \number\InCa@Sub#1!#8!!%
1531 89%
1532 }%
1533 \fi
1534 #2#3!#4!#5!#6!#7!#8!%
1535 \fi
1536 \fi
1537 \fi
1538 \ifx#2=%
1539 \expandafter\@gobble
1540 \fi
1541 /%
1542 }

```

\InCa@ProcessDiv

```

1543 \def\InCa@ProcessDiv#1!#2#3#4#5!#6!{%
1544 \ifnum#1<#6 %
1545 #2%
1546 \@ReturnAfterElseFi{%
1547 \ifx#4=%
1548 \expandafter\InCa@CleanupIV
1549 \else
1550 \@ReturnAfterFi{%
1551 \InCa@ProcessDiv{#1#4}#5!#6!%
1552 }%
1553 \fi
1554 }%
1555 \else

```

```

1556     #3%
1557     \@ReturnAfterFi{%
1558         \ifx#4=%
1559             \expandafter\InCa@CleanupIV
1560         \else
1561             \@ReturnAfterFi{%
1562                 \expandafter\InCa@ProcessDiv\expandafter{%
1563                     \number\InCa@Sub#1!#6! %
1564                     #4%
1565                 }#5!#6!%
1566             }%
1567         \fi
1568     }%
1569 \fi
1570 }

```

\InCa@CleanupIV

```

1571 \def\InCa@CleanupIV#1!#2!#3!#4!{%

```

## 2.5.12 Mod

\intcalcMod

```

1572 \def\intcalcMod#1#2{%
1573     \number\expandafter\InCa@Mod
1574     \number\number#1\expandafter!%
1575     \number#2! %
1576 }

```

\intcalc@Mod Pseudocode/decision table for \intcalc@Mod.

```

if       $y = 0$     DivisionByZero
elsif    $y < 0$      $-\text{Mod}(-x, -y)$ 
elsif    $x = 0$     0
elsif    $y = 1$     0
elsif    $y = 2$      $\text{ifodd}(x) ? 1 : 0$ 
elsif    $x < 0$      $z \leftarrow x - (x/y) * y; \quad (z < 0) ? z + y : z$ 
else      $x - (x/y) * y$ 

```

```

1577 \def\InCa@Mod#1!#2!{%
1578     \ifcase#2 %
1579         0\IntCalcError:DivisionByZero%
1580     \else
1581         \ifnum#2<\z@
1582             -%
1583             \expandafter\InCa@Mod
1584             \number-#1\expandafter!%
1585             \number-#2!%
1586         \else
1587             \ifcase#1 %
1588                 0%
1589             \else
1590                 \ifcase#2 % 0 already caught
1591                 \IntCalcError:ThisCannotHappen%
1592                 \or % 1
1593                     0%
1594                 \or % 2
1595                     \ifodd#1 1\else 0\fi
1596                 \else
1597                     \ifnum#1<\z@
1598                         \expandafter\InCa@ModShift
1599                         \number-%

```

```

1600             \expandafter\InCa@Sub
1601             \number\@gobble#1\expandafter!%
1602             \number\intcalcMul{#2}{%
1603             \expandafter\InCa@Div\@gobble#1!#2!%
1604             }!%
1605             !#2!%
1606         \else
1607             \expandafter\InCa@Sub\number#1\expandafter!%
1608             \number\intcalcMul{#2}{\InCa@Div#1!#2!}%
1609         \fi
1610     \fi
1611 \fi
1612 \fi
1613 \fi
1614 }

```

\IntCalcMod

```

1615 \def\InCa@Temp#1{%
1616   \def\IntCalcMod##1!##2!{%
1617     \number
1618     \ifcase##2 %
1619       0\IntCalcError:DivisionByZero%
1620     \else
1621       \ifcase##1 %
1622         0%
1623       \else
1624         \ifcase##2 % 0 already caught
1625       ? \IntCalcError:ThisCannotHappen
1626       \or % 1
1627         0%
1628       \or % 2
1629         \ifodd ##1 1\else 0\fi
1630     \else
1631       \expandafter\InCa@Sub\number##1\expandafter!%
1632       \number\intcalcMul{##2}{\InCa@Div##1!##2!}%
1633     \fi
1634   \fi
1635 \fi
1636   #1%
1637 }%
1638 }
1639 \InCa@Temp{ }%

```

\InCa@ModShift

```

1640 \def\InCa@ModShift#1!#2!{%
1641   \ifnum#1<\z@
1642     \expandafter\InCa@Sub\number#2\expandafter!%
1643     \@gobble#1!%
1644   \else
1645     #1%
1646   \fi
1647 }

```

## 2.5.13 Help macros

\InCa@Empty

```

1648 \def\InCa@Empty{}

```

\@gobble

```

1649 \expandafter\ifx\csname \@gobble\endcsname\relax
1650 \long\def\@gobble#1{}%
1651 \fi

```



```

\@ReturnAfterFi
1652 \long\def\@ReturnAfterFi#1\fi{\fi#1}%

\@ReturnAfterElseFi
1653 \long\def\@ReturnAfterElseFi#1\else#2\fi{\fi#1}%

1654 \InCa@AtEnd
1655 \</package>

```

## 3 Test

### 3.1 Catcode checks for loading

```

1656 <*test1>

1657 \catcode'\@=11 %
1658 \def\RestoreCatcodes{}
1659 \count@=0 %
1660 \loop
1661   \edef\RestoreCatcodes{%
1662     \RestoreCatcodes
1663     \catcode\the\count@=\the\catcode\count@\relax
1664   }%
1665 \ifnum\count@<255 %
1666   \advance\count@\@ne
1667 \repeat
1668
1669 \def\RangeCatcodeInvalid#1#2{%
1670   \count@=#1\relax
1671   \loop
1672     \catcode\count@=15 %
1673   \ifnum\count@<#2\relax
1674     \advance\count@\@ne
1675   \repeat
1676 }
1677 \def\Test{%
1678   \RangeCatcodeInvalid{0}{47}%
1679   \RangeCatcodeInvalid{58}{64}%
1680   \RangeCatcodeInvalid{91}{96}%
1681   \RangeCatcodeInvalid{123}{255}%
1682   \catcode'\@=12 %
1683   \catcode'\=0 %
1684   \catcode'\{=1 %
1685   \catcode'\}=2 %
1686   \catcode'\#=6 %
1687   \catcode'\[=12 %
1688   \catcode'\]=12 %
1689   \catcode'\%=14 %
1690   \catcode'\ =10 %
1691   \catcode13=5 %
1692   \input intcalc.sty\relax
1693   \RestoreCatcodes
1694 }
1695 \Test
1696 \csname @@end\endcsname
1697 \end
1698 </test1>

```

### 3.2 Macro tests

#### 3.2.1 Preamble with test macro definitions

```

1699 <*test2 | test4>
1700 \NeedsTeXFormat{LaTeX2e}
1701 \nofiles
1702 \documentclass{article}
1703 <noetex> \let \SavedNumexpr \numexpr
1704 <noetex> \let \numexpr \UNDEFINED
1705 \makeatletter
1706 \chardef \InCa@TestMode=1 %
1707 \makeatother
1708 \usepackage{intcalc}[2007/09/27]
1709 <noetex> \let \numexpr \SavedNumexpr
1710 \usepackage{qstest}
1711 \IncludeTests{*}
1712 \LogTests{log}{*}{*}
1713 </test2 | test4>
1714 <*test2>
1715 \newcommand*{\TestSpaceAtEnd}[1]{%
1716 <noetex> \let \SavedNumexpr \numexpr
1717 <noetex> \let \numexpr \UNDEFINED
1718 \edef\resultA{#1}%
1719 \edef\resultB{#1 }%
1720 <noetex> \let \numexpr \SavedNumexpr
1721 \Expect*{\resultA\space}*{\resultB}%
1722 }
1723 \newcommand*{\TestResult}[2]{%
1724 <noetex> \let \SavedNumexpr \numexpr
1725 <noetex> \let \numexpr \UNDEFINED
1726 \edef\result{#1}%
1727 <noetex> \let \numexpr \SavedNumexpr
1728 \Expect*{\result}{#2}%
1729 }
1730 \newcommand*{\TestResultTwoExpansions}[2]{%
1731 <*noetex>
1732 \begingroup
1733 \let \numexpr \UNDEFINED
1734 \expandafter \expandafter \expandafter
1735 \endgroup
1736 </noetex>
1737 \expandafter \expandafter \expandafter \Expect
1738 \expandafter \expandafter \expandafter {#1}{#2}%
1739 }
1740 \newcount \TestCount
1741 <etex> \newcommand*{\TestArg}[1]{\numexpr #1 \relax}
1742 <noetex> \newcommand*{\TestArg}[1]{#1}
1743 \newcommand*{\TestTeXDivide}[2]{%
1744 \TestCount=\TestArg{#1} \relax
1745 \divide \TestCount by \TestArg{#2} \relax
1746 \Expect*{\intcalcDiv{#1}{#2}}*{\the \TestCount}%
1747 }
1748 \newcommand*{\Test}[2]{%
1749 \TestResult{#1}{#2}%
1750 \TestResultTwoExpansions{#1}{#2}%
1751 \TestSpaceAtEnd{#1}%
1752 }
1753 \newcommand*{\TestExch}[2]{\Test{#2}{#1}}
1754 \newcommand*{\TestInv}[2]{%
1755 \Test{\intcalcInv{#1}}{#2}%
1756 }
1757 \newcommand*{\TestNum}[2]{%
1758 \Test{\intcalcNum{#1}}{#2}%
1759 }
1760 \newcommand*{\TestAbs}[2]{%

```

```

1761 \Test{\intcalcAbs{#1}}{#2}%
1762 }
1763 \newcommand*{\TestSgn}[2]{%
1764 \Test{\intcalcSgn{#1}}{#2}%
1765 }
1766 \newcommand*{\TestMin}[3]{%
1767 \Test{\intcalcMin{#1}{#2}}{#3}%
1768 }
1769 \newcommand*{\TestMax}[3]{%
1770 \Test{\intcalcMax{#1}{#2}}{#3}%
1771 }
1772 \newcommand*{\TestCmp}[3]{%
1773 \Test{\intcalcCmp{#1}{#2}}{#3}%
1774 }
1775 \newcommand*{\TestInc}[2]{%
1776 \Test{\intcalcInc{#1}}{#2}%
1777 \ifnum\intcalcNum{#1}>-1 %
1778 \edef\x{%
1779 \noexpand\Test{%
1780 \noexpand\IntCalcInc\intcalcNum{#1}!%
1781 }{#2}%
1782 }%
1783 \x
1784 \fi
1785 }
1786 \newcommand*{\TestDec}[2]{%
1787 \Test{\intcalcDec{#1}}{#2}%
1788 \ifnum\intcalcNum{#1}>0 %
1789 \edef\x{%
1790 \noexpand\Test{%
1791 \noexpand\IntCalcDec\intcalcNum{#1}!%
1792 }{#2}%
1793 }%
1794 \x
1795 \fi
1796 }
1797 \newcommand*{\TestAdd}[3]{%
1798 \Test{\intcalcAdd{#1}{#2}}{#3}%
1799 \ifnum\intcalcNum{#1}>0 %
1800 \ifnum\intcalcNum{#2}> 0 %
1801 \ifnum\intcalcCmp{#1}{#2}>0 %
1802 \edef\x{%
1803 \noexpand\Test{%
1804 \noexpand\IntCalcAdd
1805 \intcalcNum{#1}!\intcalcNum{#2}!%
1806 }{#3}%
1807 }%
1808 \x
1809 \else
1810 \edef\x{%
1811 \noexpand\Test{%
1812 \noexpand\IntCalcAdd
1813 \intcalcNum{#2}!\intcalcNum{#1}!%
1814 }{#3}%
1815 }%
1816 \x
1817 \fi
1818 \fi
1819 \fi
1820 }
1821 \newcommand*{\TestSub}[3]{%
1822 \Test{\intcalcSub{#1}{#2}}{#3}%

```

```

1823 \ifnum\intcalcNum{#1}>0 %
1824 \ifnum\intcalcNum{#2}> 0 %
1825 \ifnum\intcalcCmp{#1}{#2}>0 %
1826 \edef\x{%
1827 \noexpand\Test{%
1828 \noexpand\IntCalcSub
1829 \intcalcNum{#1}!\intcalcNum{#2}!%
1830 }{#3}%
1831 }%
1832 \x
1833 \fi
1834 \fi
1835 \fi
1836 }
1837 \newcommand*\TestShl}[2]{%
1838 \Test{\intcalcShl{#1}{#2}%
1839 \edef\x{%
1840 \noexpand\Test{%
1841 \noexpand\IntCalcShl\intcalcAbs{#1}!%
1842 }{\intcalcAbs{#2}}%
1843 }%
1844 \x
1845 }
1846 \newcommand*\TestShr}[2]{%
1847 \Test{\intcalcShr{#1}{#2}%
1848 \edef\x{%
1849 \noexpand\Test{%
1850 \noexpand\IntCalcShr\intcalcAbs{#1}!%
1851 }{\intcalcAbs{#2}}%
1852 }%
1853 \x
1854 }
1855 \newcommand*\TestMul}[3]{%
1856 \Test{\intcalcMul{#1}{#2}{#3}%
1857 \edef\x{%
1858 \noexpand\Test{%
1859 \noexpand\IntCalcMul\intcalcAbs{#1}!\intcalcAbs{#2}!%
1860 }{\intcalcAbs{#3}}%
1861 }%
1862 \x
1863 }
1864 \newcommand*\TestSqr}[2]{%
1865 \Test{\intcalcSqr{#1}{#2}%
1866 }
1867 \newcommand*\TestFac}[2]{%
1868 \expandafter\TestExch\expandafter{\the\numexpr#2}{\intcalcFac{#1}}%
1869 }
1870 \newcommand*\TestPow}[3]{%
1871 \Test{\intcalcPow{#1}{#2}{#3}%
1872 }
1873 \newcommand*\TestDiv}[3]{%
1874 \Test{\intcalcDiv{#1}{#2}{#3}%
1875 \TestTeXDivide{#1}{#2}%
1876 \edef\x{%
1877 \noexpand\Test{%
1878 \noexpand\IntCalcDiv\intcalcAbs{#1}!\intcalcAbs{#2}!%
1879 }{\intcalcAbs{#3}}%
1880 }%
1881 }
1882 \newcommand*\TestMod}[3]{%
1883 \Test{\intcalcMod{#1}{#2}{#3}%
1884 \ifcase\ifcase\intcalcSgn{#1} 0%

```

```

1885         \or
1886         \ifcase\intcalcSgn{#2} 1%
1887         \or 0%
1888         \else 1%
1889         \fi
1890     \else
1891         \ifcase\intcalcSgn{#2} 1%
1892         \or 1%
1893         \else 0%
1894         \fi
1895     \fi\relax
1896 \edef\x{%
1897     \noexpand\Test{%
1898     \noexpand\IntCalcMod
1899     \intcalcAbs{#1}!\intcalcAbs{#2}!%
1900     }\intcalcAbs{#3}}%
1901 }%
1902 \x
1903 \fi
1904 }
1905 </test2>

```

### 3.2.2 Time

```

1906 <*test2>
1907 \begingroup\expandafter\expandafter\expandafter\endgroup
1908 \expandafter\ifx\cename pdfresettimer\endcename\relax
1909 \else
1910     \makeatletter
1911     \newcount\SummaryTime
1912     \newcount\TestTime
1913     \SummaryTime=\z@
1914     \newcommand*\PrintTime}[2]{%
1915         \typeout{%
1916             [Time #1: \strip@pt\dimexpr\number#2sp\relax\space s]%
1917         }%
1918     }%
1919     \newcommand*\StartTime#[1]{%
1920         \renewcommand*\TimeDescription}{#1}%
1921         \pdfresettimer
1922     }%
1923     \newcommand*\TimeDescription{}%
1924     \newcommand*\StopTime{}%
1925     \TestTime=\pdfelapseddtime
1926     \global\advance\SummaryTime\TestTime
1927     \PrintTime\TimeDescription\TestTime
1928 }%
1929 \let\saved@qstest\qstest
1930 \let\saved@endqstest\endqstest
1931 \def\qstest#1#2{%
1932     \saved@qstest{#1}{#2}%
1933     \StartTime{#1}%
1934 }%
1935 \def\endqstest{%
1936     \StopTime
1937     \saved@endqstest
1938 }%
1939 \AtEndDocument{%
1940     \PrintTime{summary}\SummaryTime
1941 }%
1942 \makeatother
1943 \fi
1944 </test2>

```

### 3.2.3 Test 4: additional mod/div operations

```

1945 <*test4>
1946 \newcommand*{\TestDo}[2]{%
1947   \ifcase\numexpr#2\relax
1948   \else
1949     \edef\temp{\intcalcMod{#1}{#2}}%
1950     \Expect*{%
1951       \the\numexpr
1952       \intcalcMul{%
1953         \intcalcDiv{\intcalcAbs{#1}}{\intcalcAbs{#2}}%
1954         }\intcalcAbs{#2}}%
1955       +\intcalcMod{\intcalcAbs{#1}}{\intcalcAbs{#2}}\relax
1956     }*{\the\numexpr\intcalcAbs{#1}\relax}%
1957   \fi
1958 }
1959 \newcommand*{\TestOne}[2]{%
1960   \TestDo{#1}{#1}%
1961 }
1962 \newcommand*{\TestTwo}[3]{%
1963   \TestDo{#1}{#2}%
1964   \TestDo{#2}{#1}%
1965 }
1966 \let\TestNum\TestOne
1967 \let\TestInv\TestOne
1968 \let\TestAbs\TestOne
1969 \let\TestSgn\TestOne
1970 \let\TestMin\TestTwo
1971 \let\TestMax\TestTwo
1972 \let\TestCmp\TestTwo
1973 \let\TestInc\TestOne
1974 \let\TestDec\TestOne
1975 \let\TestAdd\TestTwo
1976 \let\TestSub\TestTwo
1977 \let\TestShl\TestOne
1978 \let\TestShr\TestOne
1979 \let\TestMul\TestTwo
1980 \let\TestSqr\TestOne
1981 \def\TestFac#1#2{}
1982 \let\TestPow\TestTwo
1983 \let\TestDiv\TestTwo
1984 \let\TestMod\TestTwo
1985 </test4>

```

### 3.2.4 Test sets

```

1986 <*test2 | test4>
1987 \makeatletter
1988
1989 \begin{qstest}{num}{num}%
1990   \TestNum{0}{0}%
1991   \TestNum{1}{1}%
1992   \TestNum{-1}{-1}%
1993   \TestNum{10}{10}%
1994   \TestNum{-10}{-10}%
1995   \TestNum{2147483647}{2147483647}%
1996   \TestNum{-2147483647}{-2147483647}%
1997   \TestNum{ 0 }{0}%
1998   \TestNum{ 1 }{1}%
1999   \TestNum{--1}{1}%
2000   \TestNum{ - + - + 4 }{4}%
2001   \TestNum{\z@}{0}%
2002   \TestNum{@ne}{1}%
2003   \TestNum{\m@ne}{-1}%

```

```

2004 <*etex>
2005   \TestNum{-10+30}{20}%
2006   \TestNum{10-30}{-20}%
2007 </etex>
2008 \end{qstest}
2009
2010 \begin{qstest}{inv}{inv}%
2011   \TestInv{0}{0}%
2012   \TestInv{1}{-1}%
2013   \TestInv{-1}{1}%
2014   \TestInv{10}{-10}%
2015   \TestInv{-10}{10}%
2016   \TestInv{2147483647}{-2147483647}%
2017   \TestInv{-2147483647}{2147483647}%
2018   \TestInv{ 0 }{0}%
2019   \TestInv{ 1 }{-1}%
2020   \TestInv{--1}{-1}%
2021   \TestInv{\z0}{0}%
2022   \TestInv{\@ne}{-1}%
2023   \TestInv{\m@ne}{1}%
2024 <*etex>
2025   \TestInv{-10+30}{-20}%
2026   \TestInv{10-30}{20}%
2027 </etex>
2028 \end{qstest}
2029
2030 \begin{qstest}{abs}{abs}%
2031   \TestAbs{0}{0}%
2032   \TestAbs{1}{1}%
2033   \TestAbs{-1}{1}%
2034   \TestAbs{10}{10}%
2035   \TestAbs{-10}{10}%
2036   \TestAbs{2147483647}{2147483647}%
2037   \TestAbs{-2147483647}{2147483647}%
2038   \TestAbs{ 0 }{0}%
2039   \TestAbs{ 1 }{1}%
2040   \TestAbs{--1}{1}%
2041   \TestAbs{\z0}{0}%
2042   \TestAbs{\@ne}{1}%
2043   \TestAbs{\m@ne}{1}%
2044 <*etex>
2045   \TestAbs{-10+30}{20}%
2046   \TestAbs{10-30}{20}%
2047 </etex>
2048 \end{qstest}
2049
2050 \begin{qstest}{sign}{sign}%
2051   \TestSgn{0}{0}%
2052   \TestSgn{1}{1}%
2053   \TestSgn{-1}{-1}%
2054   \TestSgn{10}{1}%
2055   \TestSgn{-10}{-1}%
2056   \TestSgn{2147483647}{1}%
2057   \TestSgn{-2147483647}{-1}%
2058   \TestSgn{ 0 }{0}%
2059   \TestSgn{ 2 }{1}%
2060   \TestSgn{ -2 }{-1}%
2061   \TestSgn{--2}{1}%
2062   \TestSgn{\z0}{0}%
2063   \TestSgn{\@ne}{1}%
2064   \TestSgn{\m@ne}{-1}%
2065 <*etex>

```

```

2066 \TestSgn{-10+30}{1}%
2067 \TestSgn{10-30}{-1}%
2068 </etex>
2069 \end{qstest}
2070
2071 \begin{qstest}{min}{min}%
2072 \TestMin{0}{1}{0}%
2073 \TestMin{1}{0}{0}%
2074 \TestMin{-10}{-20}{-20}%
2075 \TestMin{ 1 }{ 2 }{1}%
2076 \TestMin{ 2 }{ 1 }{1}%
2077 \TestMin{1}{1}{1}%
2078 \TestMin{\z@}{\@ne}{0}%
2079 \TestMin{\@ne}{\m@ne}{-1}%
2080 <*etex>
2081 \TestMin{1+2}{3+4}{3}%
2082 </etex>
2083 \end{qstest}
2084
2085 \begin{qstest}{max}{max}%
2086 \TestMax{0}{1}{1}%
2087 \TestMax{1}{0}{1}%
2088 \TestMax{-10}{-20}{-10}%
2089 \TestMax{ 1 }{ 2 }{2}%
2090 \TestMax{ 2 }{ 1 }{2}%
2091 \TestMax{1}{1}{1}%
2092 \TestMax{\z@}{\@ne}{1}%
2093 \TestMax{\@ne}{\m@ne}{1}%
2094 <*etex>
2095 \TestMax{1+2}{3+4}{7}%
2096 </etex>
2097 \end{qstest}
2098
2099 \begin{qstest}{cmp}{cmp}%
2100 \TestCmp{0}{0}{0}%
2101 \TestCmp{-21}{17}{-1}%
2102 \TestCmp{3}{4}{-1}%
2103 \TestCmp{-10}{-10}{0}%
2104 \TestCmp{-10}{-11}{1}%
2105 \TestCmp{100}{5}{1}%
2106 \TestCmp{2147483647}{-2147483647}{1}%
2107 \TestCmp{-2147483647}{2147483647}{-1}%
2108 \TestCmp{2147483647}{2147483647}{0}%
2109 \TestCmp{\z@}{\@ne}{-1}%
2110 \TestCmp{\@ne}{\m@ne}{1}%
2111 \TestCmp{ 4 }{ 5 }{-1}%
2112 \TestCmp{ -3 }{ -7 }{1}%
2113 <*etex>
2114 \TestCmp{1+2}{3+4}{-1}%
2115 </etex>
2116 \end{qstest}
2117
2118 \begin{qstest}{fac}{fac}
2119 \TestFac{0}{1}%
2120 \TestFac{1}{1}%
2121 \TestFac{2}{2}%
2122 \TestFac{3}{2*3}%
2123 \TestFac{4}{2*3*4}%
2124 \TestFac{5}{2*3*4*5}%
2125 \TestFac{6}{2*3*4*5*6}%
2126 \TestFac{7}{2*3*4*5*6*7}%
2127 \TestFac{8}{2*3*4*5*6*7*8}%

```



```

2128 \TestFac{9}{2*3*4*5*6*7*8*9}%
2129 \TestFac{10}{2*3*4*5*6*7*8*9*10}%
2130 \TestFac{11}{2*3*4*5*6*7*8*9*10*11}%
2131 \TestFac{12}{2*3*4*5*6*7*8*9*10*11*12}%
2132 \end{qstest}
2133
2134 \begin{qstest}{inc}{inc}%
2135 \TestInc{0}{1}%
2136 \TestInc{1}{2}%
2137 \TestInc{-1}{0}%
2138 \TestInc{10}{11}%
2139 \TestInc{-10}{-9}%
2140 \TestInc{999}{1000}%
2141 \TestInc{-1000}{-999}%
2142 \TestInc{129}{130}%
2143 \TestInc{2147483646}{2147483647}%
2144 \TestInc{-2147483647}{-2147483646}%
2145 \end{qstest}
2146
2147 \begin{qstest}{dec}{dec}%
2148 \TestDec{0}{-1}%
2149 \TestDec{1}{0}%
2150 \TestDec{-1}{-2}%
2151 \TestDec{10}{9}%
2152 \TestDec{-10}{-11}%
2153 \TestDec{1000}{999}%
2154 \TestDec{-999}{-1000}%
2155 \TestDec{130}{129}%
2156 \TestDec{2147483647}{2147483646}%
2157 \TestDec{-2147483646}{-2147483647}%
2158 \end{qstest}
2159
2160 \begin{qstest}{add}{add}%
2161 \TestAdd{0}{0}{0}%
2162 \TestAdd{1}{0}{1}%
2163 \TestAdd{0}{1}{1}%
2164 \TestAdd{1}{2}{3}%
2165 \TestAdd{-1}{-1}{-2}%
2166 \TestAdd{2147483646}{1}{2147483647}%
2167 \TestAdd{-2147483647}{2147483647}{0}%
2168 \TestAdd{20}{-5}{15}%
2169 \TestAdd{-4}{-1}{-5}%
2170 \TestAdd{-1}{-4}{-5}%
2171 \TestAdd{-4}{1}{-3}%
2172 \TestAdd{-1}{4}{3}%
2173 \TestAdd{4}{-1}{3}%
2174 \TestAdd{1}{-4}{-3}%
2175 \TestAdd{-4}{-1}{-5}%
2176 \TestAdd{-1}{-4}{-5}%
2177 \TestAdd{ -4 }{ -1 }{-5}%
2178 \TestAdd{ -1 }{ -4 }{-5}%
2179 \TestAdd{ -4 }{ 1 }{-3}%
2180 \TestAdd{ -1 }{ 4 }{3}%
2181 \TestAdd{ 4 }{ -1 }{3}%
2182 \TestAdd{ 1 }{ -4 }{-3}%
2183 \TestAdd{ -4 }{ -1 }{-5}%
2184 \TestAdd{ -1 }{ -4 }{-5}%
2185 \TestAdd{876543210}{111111111}{987654321}%
2186 \TestAdd{999999999}{2}{1000000001}%
2187 \langle *etex \rangle
2188 \TestAdd{100}{50+150}{300}%
2189 \TestAdd{2147483647}{10-2147483647}{10}%

```

```

2190 </etex>
2191 \end{qstest}
2192
2193 \begin{qstest}{sub}{sub}
2194 \TestSub{0}{0}{0}%
2195 \TestSub{1}{0}{1}%
2196 \TestSub{1}{2}{-1}%
2197 \TestSub{-1}{-1}{0}%
2198 \TestSub{2147483646}{-1}{2147483647}%
2199 \TestSub{-2147483647}{-2147483647}{0}%
2200 \TestSub{-4}{-1}{-3}%
2201 \TestSub{-1}{-4}{3}%
2202 \TestSub{-4}{1}{-5}%
2203 \TestSub{-1}{4}{-5}%
2204 \TestSub{4}{-1}{5}%
2205 \TestSub{1}{-4}{5}%
2206 \TestSub{-4}{-1}{-3}%
2207 \TestSub{-1}{-4}{3}%
2208 \TestSub{ -4 }{ -1 }{-3}%
2209 \TestSub{ -1 }{ -4 }{3}%
2210 \TestSub{ -4 }{ 1 }{-5}%
2211 \TestSub{ -1 }{ 4 }{-5}%
2212 \TestSub{ 4 }{ -1 }{5}%
2213 \TestSub{ 1 }{ -4 }{5}%
2214 \TestSub{ -4 }{ -1 }{-3}%
2215 \TestSub{ -1 }{ -4 }{3}%
2216 \TestSub{1000000000}{2}{999999998}%
2217 \TestSub{987654321}{111111111}{876543210}%
2218 <*etex>
2219 \TestSub{100}{50+150}{-100}%
2220 \TestSub{2147483647}{-10+2147483647}{10}%
2221 </etex>
2222 \end{qstest}
2223
2224 \begin{qstest}{shl}{shl}
2225 \TestShl{0}{0}%
2226 \TestShl{1}{2}%
2227 \TestShl{5621}{11242}%
2228 \TestShl{1073741823}{2147483646}%
2229 \TestShl{-1}{-2}%
2230 \TestShl{-5621}{-11242}%
2231 \end{qstest}
2232
2233 \begin{qstest}{shr}{shr}
2234 \TestShr{0}{0}%
2235 \TestShr{1}{0}%
2236 \TestShr{2}{1}%
2237 \TestShr{3}{1}%
2238 \TestShr{4}{2}%
2239 \TestShr{5}{2}%
2240 \TestShr{6}{3}%
2241 \TestShr{7}{3}%
2242 \TestShr{8}{4}%
2243 \TestShr{9}{4}%
2244 \TestShr{10}{5}%
2245 \TestShr{11}{5}%
2246 \TestShr{12}{6}%
2247 \TestShr{13}{6}%
2248 \TestShr{14}{7}%
2249 \TestShr{15}{7}%
2250 \TestShr{16}{8}%
2251 \TestShr{17}{8}%

```

```

2252 \TestShr{18}{9}%
2253 \TestShr{19}{9}%
2254 \TestShr{20}{10}%
2255 \TestShr{21}{10}%
2256 \TestShr{22}{11}%
2257 \TestShr{11241}{5620}%
2258 \TestShr{73054202}{36527101}%
2259 \TestShr{2147483646}{1073741823}%
2260 \TestShr{-1}{0}%
2261 \TestShr{-2}{-1}%
2262 \TestShr{-3}{-1}%
2263 \TestShr{-11241}{-5620}%
2264 \end{qstest}
2265
2266 \begin{qstest}{mul}{mul}
2267 \TestMul{0}{0}{0}%
2268 \TestMul{1}{0}{0}%
2269 \TestMul{0}{1}{0}%
2270 \TestMul{1}{1}{1}%
2271 \TestMul{3}{1}{3}%
2272 \TestMul{1}{-3}{-3}%
2273 \TestMul{-4}{-5}{20}%
2274 \TestMul{3}{7}{21}%
2275 \TestMul{7}{3}{21}%
2276 \TestMul{3}{-7}{-21}%
2277 \TestMul{7}{-3}{-21}%
2278 \TestMul{-3}{7}{-21}%
2279 \TestMul{-7}{3}{-21}%
2280 \TestMul{-3}{-7}{21}%
2281 \TestMul{-7}{-3}{21}%
2282 \TestMul{12}{11}{132}%
2283 \TestMul{999}{333}{332667}%
2284 \TestMul{1000}{4321}{4321000}%
2285 \TestMul{12345}{173955}{2147474475}%
2286 \TestMul{1073741823}{2}{2147483646}%
2287 \TestMul{2}{1073741823}{2147483646}%
2288 \TestMul{-1073741823}{2}{-2147483646}%
2289 \TestMul{2}{-1073741823}{-2147483646}%
2290 \etex
2291 \TestMul{2+3}{5+7}{60}%
2292 \TestMul{2147483647}{2147483647/2147483647}{2147483647}%
2293 \etex
2294 \end{qstest}
2295
2296 \begin{qstest}{sqr}{sqr}
2297 \TestSqr{0}{0}%
2298 \TestSqr{1}{1}%
2299 \TestSqr{2}{4}%
2300 \TestSqr{3}{9}%
2301 \TestSqr{4}{16}%
2302 \TestSqr{9}{81}%
2303 \TestSqr{10}{100}%
2304 \TestSqr{46340}{2147395600}%
2305 \TestSqr{-1}{1}%
2306 \TestSqr{-2}{4}%
2307 \TestSqr{-46340}{2147395600}%
2308 \end{qstest}
2309
2310 \begin{qstest}{pow}{pow}
2311 \TestPow{-2}{0}{1}%
2312 \TestPow{-1}{0}{1}%
2313 \TestPow{0}{0}{1}%

```

```

2314 \TestPow{1}{0}{1}%
2315 \TestPow{2}{0}{1}%
2316 \TestPow{3}{0}{1}%
2317 \TestPow{-2}{1}{-2}%
2318 \TestPow{-1}{1}{-1}%
2319 \TestPow{1}{1}{1}%
2320 \TestPow{2}{1}{2}%
2321 \TestPow{3}{1}{3}%
2322 \TestPow{-2}{2}{4}%
2323 \TestPow{-1}{2}{1}%
2324 \TestPow{0}{2}{0}%
2325 \TestPow{1}{2}{1}%
2326 \TestPow{2}{2}{4}%
2327 \TestPow{3}{2}{9}%
2328 \TestPow{0}{1}{0}%
2329 \TestPow{1}{-2}{1}%
2330 \TestPow{1}{-1}{1}%
2331 \TestPow{-1}{-2}{1}%
2332 \TestPow{-1}{-1}{-1}%
2333 \TestPow{-1}{3}{-1}%
2334 \TestPow{-1}{4}{1}%
2335 \TestPow{-2}{-1}{0}%
2336 \TestPow{-2}{-2}{0}%
2337 \TestPow{2}{3}{8}%
2338 \TestPow{2}{4}{16}%
2339 \TestPow{2}{5}{32}%
2340 \TestPow{2}{6}{64}%
2341 \TestPow{2}{7}{128}%
2342 \TestPow{2}{8}{256}%
2343 \TestPow{2}{9}{512}%
2344 \TestPow{2}{10}{1024}%
2345 \TestPow{-2}{3}{-8}%
2346 \TestPow{-2}{4}{16}%
2347 \TestPow{-2}{5}{-32}%
2348 \TestPow{-2}{6}{64}%
2349 \TestPow{-2}{7}{-128}%
2350 \TestPow{-2}{8}{256}%
2351 \TestPow{-2}{9}{-512}%
2352 \TestPow{-2}{10}{1024}%
2353 \TestPow{3}{3}{27}%
2354 \TestPow{3}{4}{81}%
2355 \TestPow{3}{5}{243}%
2356 \TestPow{-3}{3}{-27}%
2357 \TestPow{-3}{4}{81}%
2358 \TestPow{-3}{5}{-243}%
2359 \TestPow{2}{30}{1073741824}%
2360 \TestPow{-3}{19}{-1162261467}%
2361 \TestPow{5}{13}{1220703125}%
2362 \TestPow{-7}{11}{-1977326743}%
2363 \end{qstest}
2364
2365 \begin{qstest}{div}{div}
2366 \TestDiv{1}{1}{1}%
2367 \TestDiv{2}{1}{2}%
2368 \TestDiv{-2}{1}{-2}%
2369 \TestDiv{2}{-1}{-2}%
2370 \TestDiv{-2}{-1}{2}%
2371 \TestDiv{15}{2}{7}%
2372 \TestDiv{-16}{2}{-8}%
2373 \TestDiv{1}{2}{0}%
2374 \TestDiv{1}{3}{0}%
2375 \TestDiv{2}{3}{0}%

```

```

2376 \TestDiv{-2}{3}{0}%
2377 \TestDiv{2}{-3}{0}%
2378 \TestDiv{-2}{-3}{0}%
2379 \TestDiv{13}{3}{4}%
2380 \TestDiv{-13}{-3}{4}%
2381 \TestDiv{-13}{3}{-4}%
2382 \TestDiv{-6}{5}{-1}%
2383 \TestDiv{-5}{5}{-1}%
2384 \TestDiv{-4}{5}{0}%
2385 \TestDiv{-3}{5}{0}%
2386 \TestDiv{-2}{5}{0}%
2387 \TestDiv{-1}{5}{0}%
2388 \TestDiv{0}{5}{0}%
2389 \TestDiv{1}{5}{0}%
2390 \TestDiv{2}{5}{0}%
2391 \TestDiv{3}{5}{0}%
2392 \TestDiv{4}{5}{0}%
2393 \TestDiv{5}{5}{1}%
2394 \TestDiv{6}{5}{1}%
2395 \TestDiv{-5}{4}{-1}%
2396 \TestDiv{-4}{4}{-1}%
2397 \TestDiv{-3}{4}{0}%
2398 \TestDiv{-2}{4}{0}%
2399 \TestDiv{-1}{4}{0}%
2400 \TestDiv{0}{4}{0}%
2401 \TestDiv{1}{4}{0}%
2402 \TestDiv{2}{4}{0}%
2403 \TestDiv{3}{4}{0}%
2404 \TestDiv{4}{4}{1}%
2405 \TestDiv{5}{4}{1}%
2406 \TestDiv{12345}{678}{18}%
2407 \TestDiv{32372}{5952}{5}%
2408 \TestDiv{284271294}{18162}{15651}%
2409 \TestDiv{217652429}{12561}{17327}%
2410 \TestDiv{462028434}{5439}{84947}%
2411 \TestDiv{2147483647}{1000}{2147483}%
2412 \TestDiv{2147483647}{-1000}{-2147483}%
2413 \TestDiv{-2147483647}{1000}{-2147483}%
2414 \TestDiv{-2147483647}{-1000}{2147483}%
2415 \end{qstest}
2416
2417 \begin{qstest}{mod}{mod}
2418 \TestMod{-6}{5}{4}%
2419 \TestMod{-5}{5}{0}%
2420 \TestMod{-4}{5}{1}%
2421 \TestMod{-3}{5}{2}%
2422 \TestMod{-2}{5}{3}%
2423 \TestMod{-1}{5}{4}%
2424 \TestMod{0}{5}{0}%
2425 \TestMod{1}{5}{1}%
2426 \TestMod{2}{5}{2}%
2427 \TestMod{3}{5}{3}%
2428 \TestMod{4}{5}{4}%
2429 \TestMod{5}{5}{0}%
2430 \TestMod{6}{5}{1}%
2431 \TestMod{-5}{4}{3}%
2432 \TestMod{-4}{4}{0}%
2433 \TestMod{-3}{4}{1}%
2434 \TestMod{-2}{4}{2}%
2435 \TestMod{-1}{4}{3}%
2436 \TestMod{0}{4}{0}%
2437 \TestMod{1}{4}{1}%

```

```

2438 \TestMod{2}{4}{2}%
2439 \TestMod{3}{4}{3}%
2440 \TestMod{4}{4}{0}%
2441 \TestMod{5}{4}{1}%
2442 \TestMod{-6}{-5}{-1}%
2443 \TestMod{-5}{-5}{0}%
2444 \TestMod{-4}{-5}{-4}%
2445 \TestMod{-3}{-5}{-3}%
2446 \TestMod{-2}{-5}{-2}%
2447 \TestMod{-1}{-5}{-1}%
2448 \TestMod{0}{-5}{0}%
2449 \TestMod{1}{-5}{-4}%
2450 \TestMod{2}{-5}{-3}%
2451 \TestMod{3}{-5}{-2}%
2452 \TestMod{4}{-5}{-1}%
2453 \TestMod{5}{-5}{0}%
2454 \TestMod{6}{-5}{-4}%
2455 \TestMod{-5}{-4}{-1}%
2456 \TestMod{-4}{-4}{0}%
2457 \TestMod{-3}{-4}{-3}%
2458 \TestMod{-2}{-4}{-2}%
2459 \TestMod{-1}{-4}{-1}%
2460 \TestMod{0}{-4}{0}%
2461 \TestMod{1}{-4}{-3}%
2462 \TestMod{2}{-4}{-2}%
2463 \TestMod{3}{-4}{-1}%
2464 \TestMod{4}{-4}{0}%
2465 \TestMod{5}{-4}{-3}%
2466 \TestMod{2147483647}{1000}{647}%
2467 \TestMod{2147483647}{-1000}{-353}%
2468 \TestMod{-2147483647}{1000}{353}%
2469 \TestMod{-2147483647}{-1000}{-647}%
2470 \TestMod{ 0 }{ 4 }{0}%
2471 \TestMod{ 1 }{ 4 }{1}%
2472 \TestMod{ -1 }{ 4 }{3}%
2473 \TestMod{ 0 }{ -4 }{0}%
2474 \TestMod{ 1 }{ -4 }{-3}%
2475 \TestMod{ -1 }{ -4 }{-1}%
2476 \etex
2477 \TestMod{1+2}{1+3}{3}%
2478 \TestMod{1-2}{1+3}{3}%
2479 \TestMod{1-2}{1-4}{-1}%
2480 \TestMod{1+2}{1-4}{0}%
2481 \TestMod{1+2}{1-5}{-1}%
2482 \etex
2483 \end{qstest}
2484 \test2 | test4)
2485
2486 \test2)
2487 \newcommand*{\TestError}[2]{%
2488 \begingroup
2489 \expandafter\def\csname IntCalcError:#1\endcsname{%
2490 \Expect*{#2}{0}%
2491 \expandafter\def\csname IntCalcError:#1\endcsname{ERROR}%
2492 \Expect*{#2}{0ERROR }%
2493 \endgroup
2494 }
2495 \begin{qstest}{error}{error}
2496 \TestError{FacNegative}{\intcalcFac{-1}}%
2497 \TestError{FacNegative}{\intcalcFac{-2147483647}}%
2498 \TestError{FacOverflow}{\intcalcFac{13}}%
2499 \TestError{FacOverflow}{\intcalcFac{2147483647}}%

```

```

2500 \TestError{DivisionByZero}{\intcalcPow{0}{-1}}%
2501 \TestError{DivisionByZero}{\intcalcDiv{1}{0}}%
2502 \TestError{DivisionByZero}{\intcalcMod{1}{0}}%
2503 \TestError{DivisionByZero}{\IntCalcDiv1!0!}%
2504 \TestError{DivisionByZero}{\IntCalcMod1!0!}%
2505 \end{qstest}
2506 </test2>
2507
2508 <*test2 | test4>
2509 \begin{document}
2510 \end{document}
2511 </test2 | test4>

```

## 4 Installation

### 4.1 Download

**Package.** This package is available on CTAN<sup>1</sup>:

[CTAN:macros/latex/contrib/oberdiek/intcalc.dtx](#) The source file.

[CTAN:macros/latex/contrib/oberdiek/intcalc.pdf](#) Documentation.

**Bundle.** All the packages of the bundle ‘oberdiek’ are also available in a TDS compliant ZIP archive. There the packages are already unpacked and the documentation files are generated. The files and directories obey the TDS standard.

[CTAN:macros/latex/contrib/oberdiek/oberdiek-tds.zip](#)

*TDS* refers to the standard “A Directory Structure for T<sub>E</sub>X Files” ([CTAN:tds/tds.pdf](#)). Directories with `texmf` in their name are usually organized this way.

### 4.2 Bundle installation

**Unpacking.** Unpack the `oberdiek-tds.zip` in the TDS tree (also known as `texmf` tree) of your choice. Example (linux):

```
unzip oberdiek-tds.zip -d ~/texmf
```

**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-T<sub>E</sub>X:

```
tex intcalc.dtx
```

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

---

<sup>1</sup><http://ftp.ctan.org/tex-archive/>

```

intcalc.sty          → tex/generic/oberdiek/intcalc.sty
intcalc.pdf          → doc/latex/oberdiek/intcalc.pdf
test/intcalc-test1.tex → doc/latex/oberdiek/test/intcalc-test1.tex
test/intcalc-test2.tex → doc/latex/oberdiek/test/intcalc-test2.tex
test/intcalc-test3.tex → doc/latex/oberdiek/test/intcalc-test3.tex
test/intcalc-test4.tex → doc/latex/oberdiek/test/intcalc-test4.tex
intcalc.dtx          → source/latex/oberdiek/intcalc.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  $\text{\TeX}$  distribution (te $\text{\TeX}$ , mi $\text{\TeX}$ , ...) relies on file name databases, you must refresh these. For example, te $\text{\TeX}$  users run `texhash` or `mktextlsr`.

## 4.5 Some details for the interested

**Attached source.** The PDF documentation on CTAN also includes the `.dtx` source file. It can be extracted by AcrobatReader 6 or higher. Another option is `pdftk`, e.g. unpack the file into the current directory:

```
pdftk intcalc.pdf unpack_files output .
```

**Unpacking with  $\text{\LaTeX}$ .** The `.dtx` chooses its action depending on the format:

**plain- $\text{\TeX}$ :** Run `docstrip` and extract the files.

**$\text{\LaTeX}$ :** Generate the documentation.

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

```
latex \let\install=y\input{intcalc.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 $\text{\LaTeX}$ :

```

pdflatex intcalc.dtx
makeindex -s gind.ist intcalc.idx
pdflatex intcalc.dtx
makeindex -s gind.ist intcalc.idx
pdflatex intcalc.dtx

```

## 5 History

[2007/09/09 v1.0]

- First version.



[2007/09/27 v1.1]

- `\intcalcNum` added.
- `\intcalcShl` and `\intcalcShr` allow negative numbers. The sign is preserved.
- Reuse `\@gobble` instead of own macro `\IntCalc@Gobble`.
- Small fixes.
- Shorter internal prefix.
- Some programmer's interface.

## 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; numbers in roman refer to the code lines where the entry is used.

Symbols	
<code>\#</code> .....	1686
<code>\%</code> .....	1689
<code>\@</code> .....	1657, 1682
<code>\@ReturnAfterElseFi</code> .....	626, 637, 649, 661, 1021, 1454, 1507, 1522, 1546, <u>1653</u>
<code>\@ReturnAfterFi</code> .....	630, 641, 653, 665, 676, 687, 975, 1019, 1073, 1206, 1458, 1513, 1528, 1550, 1557, 1561, <u>1652</u>
<code>\@gobble</code> .....	567, 570, 575, 578, 585, 588, 1226, 1229, 1234, 1237, 1245, 1247, 1418, 1421, 1427, 1539, 1601, 1603, 1643, <u>1649</u>
<code>\@ne</code> .....	276, 1357, 1666, 1674, 2002, 2022, 2042, 2063, 2078, 2079, 2092, 2093, 2109, 2110
<code>\[</code> .....	1687
<code>\[</code> .....	1683
<code>\{</code> .....	1684
<code>\}</code> .....	1685
<code>\]</code> .....	1688
<code>\_</code> .....	1690
A	
<code>\advance</code> .....	1666, 1674, 1926
<code>\AtEndDocument</code> .....	1939
B	
<code>\begin</code> .....	1989, 2010, 2030, 2050, 2071, 2085, 2099, 2118, 2134, 2147, 2160, 2193, 2224, 2233, 2266, 2296, 2310, 2365, 2417, 2495, 2509
C	
<code>\catcode</code> .....	3, 4, 5, 6, 7, 31, 32, 33, 34, 35, 36, 37, 38, 56, 58, 62, 64, 81, 1657, 1663,
	1672, 1682, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1690, 1691
<code>\chardef</code> .....	1706
<code>\count@</code> .....	1659, 1663, 1665, 1666, 1670, 1672, 1673, 1674
<code>\csname</code> .....	8, 18, 39, 52, 55, 79, 149, 447, 450, 460, 466, 472, 475, 479, 481, 486, 505, 515, 517, 522, 541, 648, 660, 672, 675, 683, 686, 693, 711, 719, 831, 958, 961, 967, 972, 974, 980, 984, 1061, 1070, 1072, 1079, 1093, 1097, 1101, 1105, 1204, 1212, 1213, 1267, 1649, 1696, 1908, 2489, 2491
D	
<code>\dimexpr</code> .....	1916
<code>\divide</code> .....	1745
<code>\documentclass</code> .....	1702
E	
<code>\empty</code> .....	12
<code>\end</code> .....	1697, 2008, 2028, 2048, 2069, 2083, 2097, 2116, 2132, 2145, 2158, 2191, 2222, 2231, 2264, 2294, 2308, 2363, 2415, 2483, 2505, 2510
<code>\endcsname</code> .....	8, 18, 39, 52, 55, 79, 149, 479, 486, 487, 505, 506, 515, 522, 523, 541, 542, 672, 683, 693, 695, 697, 711, 713, 715, 719, 721, 723, 831, 833, 835, 972, 980, 981, 984, 985, 1070, 1079, 1080, 1093, 1094, 1097, 1099, 1101, 1105, 1204, 1213, 1649, 1696, 1908, 2489, 2491
<code>\endinput</code> .....	27, 414
<code>\endqstest</code> .....	1930, 1935
<code>\Expect</code> .....	1721, 1728, 1737, 1746, 1950, 2490, 2492

# I

\if	389, 390, 398	\InCa@DivStartII	1464, 1469
\ifcase	9, 127, 245, 252, 298, 301, 325, 328, 348, 351, 375, 378, 407, 489, 507, 525, 543, 611, 694, 725, 837, 986, 1031, 1056, 1098, 1108, 1262, 1315, 1326, 1386, 1389, 1401, 1404, 1435, 1578, 1587, 1590, 1618, 1621, 1624, 1884, 1886, 1891, 1947	\InCa@DivStartIII	1470, 1475
\ifnum	103, 110, 117, 120, 141, 260, 276, 306, 313, 356, 363, 562, 563, 565, 573, 582, 583, 591, 618, 712, 720, 832, 1203, 1222, 1223, 1224, 1233, 1241, 1243, 1250, 1270, 1334, 1357, 1358, 1369, 1415, 1416, 1424, 1434, 1445, 1488, 1495, 1505, 1506, 1521, 1544, 1581, 1597, 1641, 1665, 1673, 1777, 1788, 1799, 1800, 1801, 1823, 1824, 1825	\InCa@DivStartIV	1476, 1483
\ifodd	211, 217, 261, 279, 1020, 1335, 1344, 1368, 1595, 1629	\InCa@DivSwitch	1392, 1414
\ifx	10, 12, 18, 39, 47, 79, 85, 92, 95, 149, 214, 254, 266, 445, 458, 463, 478, 514, 625, 636, 647, 659, 671, 682, 957, 971, 1006, 1017, 1069, 1278, 1283, 1300, 1320, 1328, 1340, 1343, 1453, 1490, 1497, 1538, 1547, 1558, 1649, 1908	\InCa@Empty	625, 636, 647, 659, 671, 682, 1278, 1283, 1648
\immediate	20, 41	\InCa@Fac	126, 237, 1307
\InCa@@@Add	627, 646	\InCa@FirstOfOne	417, 420, 422
\InCa@@@Sub	638, 658	\InCa@Inc	451, 461, 472, 477
\InCa@@Add	614, 624	\InCa@IncDigit9	505
\InCa@@Div	304, 338, 391, 394, 400, 402, 1407, 1417, 1421, 1426, 1429, 1433	\InCa@IncDigit[0-8]	485
\InCa@@Mod	354, 388	\InCa@IncSwitch	442, 444
\InCa@@ProcessDiv	1508, 1514, 1523, 1529, 1543	\InCa@Max	109, 169, 434
\InCa@@Sub	621, 635	\InCa@Min	102, 164, 430
\InCa@@TestMode	83	\InCa@Mod	343, 347, 1573, 1577, 1583
\InCa@@TimDigitCarry	1207, 1211	\InCa@ModShift	1598, 1640
\InCa@Abs	84, 158, 424	\InCa@ModX	393, 399, 406
\InCa@Add	566, 569, 592, 594, 600, 610, 1279, 1289, 1480	\InCa@Mul	1225, 1228, 1234, 1236, 1244, 1247, 1251, 1253, 1259, 1261, 1277, 1301, 1303, 1321, 1323, 1359, 1361, 1365, 1370, 1372
\InCa@AddDigit0	711	\InCa@MulSwitch	1217, 1221
\InCa@AddDigit[1-9]	718	\InCa@Param[0-9]	1078
\InCa@AddSwitch	551, 557, 561	\InCa@Pow	240, 244, 1310, 1314
\InCa@AtEnd	60, 61, 413, 1654	\InCa@PowRec	269, 275, 1347, 1349, 1356
\InCa@CleanupIV	1548, 1559, 1571	\InCa@ProcessAdd	650, 670
\InCa@Cmp	116, 174, 438	\InCa@ProcessDiv	1484, 1486, 1551, 1562
\InCa@Dec	448, 467, 475, 513	\InCa@ProcessMul	1273, 1277, 1284, 1288
\InCa@DecDigit0	541	\InCa@ProcessSub	662, 681
\InCa@DecDigit[1-9]	521	\InCa@ProcessTim	1062, 1068
\InCa@DecSwitch	455, 457	\InCa@Sgn	91, 161, 427
\InCa@DigitCarry[0-9]	692	\InCa@Shl	959, 962, 968, 970, 976, 1268
\InCa@Div	293, 297, 1381, 1385, 1603, 1608, 1632	\InCa@ShlDigit0	980
\InCa@DivStart	1442, 1452	\InCa@ShlDigit[1-9]	983
\InCa@DivStartI	1455, 1463	\InCa@ShlSwitch	954, 956
		\InCa@Shr	205, 213, 1007, 1009, 1013, 1015, 1440
		\InCa@ShrDigit	1016, 1030
		\InCa@ShrSwitch	1003, 1005
		\InCa@Space	605, 614, 621
		\InCa@Sqr	231, 233, 1297, 1299
		\InCa@StartI	1463
		\InCa@StartII	1469
		\InCa@StartIII	1475
		\InCa@StartIV	1483
		\InCa@Sub	575, 577, 584, 588, 603, 617, 1500, 1509, 1515, 1524, 1530, 1563, 1600, 1607, 1631, 1642
		\InCa@SubDigit[0-9]	830
		\InCa@Temp	322, 337, 372, 387, 485, 496, 497, 498, 499, 500, 501, 502, 503, 504, 521, 532, 533, 534, 535, 536, 537, 538, 539, 540, 692, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 718, 731, 742, 753, 764, 775, 786, 797, 808, 819, 830, 843, 854, 865, 876, 887, 898, 909, 920, 931, 942, 983, 993, 994, 995, 996, 997, 998, 999, 1000, 1001, 1053, 1067, 1078, 1083, 1084,

1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1104, 1114, 1125, 1136, 1147, 1158, 1169, 1180, 1191, 1398, 1413, 1615, 1639	
\InCa@TestMode	83, 1706
\InCa@Tim	<u>1053</u> , <u>1271</u> , <u>1281</u> , <u>1285</u> , <u>1291</u>
\InCa@TimDigit0	<u>1093</u>
\InCa@TimDigit1	<u>1097</u>
\InCa@TimDigit[2-9]	<u>1104</u>
\InCa@TimDigitCarry	1106, <u>1202</u>
\IncludeTests	1711
\input	1692
\IntCal@ShlDigit	<u>970</u>
\intcalc@Mod	<u>1577</u>
\intcalcAbs	4, <u>157</u> , <u>423</u> , 1761, 1841, 1842, 1850, 1851, 1859, 1860, 1878, 1879, 1899, 1900, 1953, 1954, 1955, 1956
\IntCalcAdd	7, <u>195</u> , <u>599</u> , 1804, 1812
\intcalcAdd	5, <u>189</u> , <u>549</u> , 1798
\intcalcCmp	4, <u>173</u> , <u>437</u> , <u>1773</u> , 1801, 1825
\IntCalcDec	7, <u>186</u> , <u>474</u> , 1791
\intcalcDec	5, <u>180</u> , <u>454</u> , 1787
\IntCalcDiv	7, <u>322</u> , <u>1398</u> , 1878, 2503
\intcalcDiv	6, <u>292</u> , <u>1380</u> , 1746, 1874, 1953, 2501
\IntCalcError	142, 144, 255, 299, 326, 349, 376, 1329, 1387, 1402, 1436, 1579, 1591, 1619, 1625
\intcalcFac	6, <u>236</u> , <u>1306</u> , 1868, 2496, 2497, 2498, 2499
\IntCalcInc	7, <u>183</u> , <u>471</u> , 1780
\intcalcInc	5, <u>177</u> , <u>441</u> , 1776
\intcalcInv	4, <u>154</u> , <u>419</u> , 1755
\intcalcMax	4, <u>168</u> , <u>433</u> , 1770
\intcalcMin	4, <u>163</u> , <u>429</u> , 1767
\IntCalcMod	7, <u>372</u> , <u>1615</u> , 1898, 2504
\intcalcMod	6, <u>342</u> , <u>1572</u> , 1883, 1949, 1955, 2502
\IntCalcMul	7, <u>227</u> , <u>1258</u> , 1859
\intcalcMul	5, <u>224</u> , <u>1215</u> , 1602, 1608, 1632, 1856, 1952
\intcalcNum	3, <u>151</u> , 155, <u>416</u> , 1758, 1777, 1780, 1788, 1791, 1799, 1800, 1805, 1813, 1823, 1824, 1829
\intcalcPow	6, <u>239</u> , <u>1309</u> , 1871, 2500
\intcalcSgn	4, <u>160</u> , <u>426</u> , 1764, 1884, 1886, 1891
\IntCalcShl	7, <u>207</u> , <u>965</u> , 1841
\intcalcShl	5, <u>201</u> , <u>953</u> , 1466, 1473, 1481, 1838
\IntCalcShr	7, <u>210</u> , <u>1012</u> , 1850
\intcalcShr	5, <u>204</u> , <u>1002</u> , 1366, 1847
\intcalcSqr	6, <u>230</u> , <u>1296</u> , 1865
\IntCalcSub	7, <u>198</u> , <u>602</u> , 1828
\intcalcSub	5, <u>192</u> , <u>555</u> , 1822
<b>L</b>	
\LogTests	1712
\loop	1660, 1671
<b>M</b>	
\mOne	260, 1334, 2003, 2023, 2043, 2064, 2079, 2093, 2110
\makeatletter	1705, 1910, 1987
\makeatother	1707, 1942
<b>N</b>	
\NeedsTeXFormat	1700
\newcommand	1715, 1723, 1730, 1741, 1742, 1743, 1748, 1753, 1754, 1757, 1760, 1763, 1766, 1769, 1772, 1775, 1786, 1797, 1821, 1837, 1846, 1855, 1864, 1867, 1870, 1873, 1882, 1914, 1919, 1923, 1924, 1946, 1959, 1962, 2487
\newcount	1740, 1911, 1912
\nofiles	1701
\number	155, 158, 161, 164, 169, 174, 205, 231, 237, 240, 288, 293, 307, 309, 314, 316, 324, 343, 357, 359, 364, 366, 374, 417, 420, 424, 427, 430, 431, 434, 435, 438, 439, 442, 455, 472, 475, 550, 552, 553, 556, 558, 559, 566, 569, 577, 584, 600, 603, 954, 966, 1003, 1013, 1055, 1107, 1216, 1218, 1219, 1225, 1228, 1236, 1244, 1259, 1279, 1288, 1289, 1297, 1307, 1310, 1311, 1312, 1365, 1366, 1367, 1381, 1382, 1383, 1393, 1394, 1400, 1417, 1426, 1465, 1471, 1472, 1477, 1478, 1479, 1480, 1500, 1509, 1515, 1524, 1530, 1563, 1573, 1574, 1575, 1584, 1585, 1599, 1601, 1602, 1607, 1608, 1617, 1631, 1632, 1642, 1916
\numexpr	152, 158, 161, 165, 166, 170, 171, 175, 178, 181, 184, 187, 190, 193, 196, 199, 202, 205, 208, 211, 218, 220, 225, 228, 231, 234, 237, 241, 242, 250, 277, 281, 282, 283, 286, 287, 294, 295, 331, 340, 344, 345, 381, 391, 394, 400, 402, 410, 1703, 1704, 1709, 1716, 1717, 1720, 1724, 1725, 1727, 1733, 1741, 1868, 1947, 1951, 1956
<b>P</b>	
\PackageInfo	23
\pdfelapsedtime	1925
\pdfresettimer	1921
\PrintTime	1914, 1927, 1940
\ProvidesPackage	53
<b>Q</b>	
\qstest	1929, 1931
<b>R</b>	
\RangeCatcodeInvalid	1669, 1678, 1679, 1680, 1681
\renewcommand	1920

\repeat	1667, 1675	\TestInc	1775,
\RestoreCatcodes	1658, 1661, 1662, 1693		1973, 2135, 2136, 2137, 2138,
\result	1726, 1728		2139, 2140, 2141, 2142, 2143, 2144
\resultA	1718, 1721	\TestInv	1754,
\resultB	1719, 1721		1967, 2011, 2012, 2013, 2014,
\romannumeral	305, 312, 355, 362, 673, 684		2015, 2016, 2017, 2018, 2019,
			2020, 2021, 2022, 2023, 2025, 2026
<b>S</b>			
\saved@endqstest	1930, 1937	\TestMax	1769, 1971, 2086, 2087, 2088,
\saved@qstest	1929, 1932		2089, 2090, 2091, 2092, 2093, 2095
\SavedNumexpr	1703, 1709, 1716, 1720, 1724, 1727	\TestMin	1766, 1970, 2072, 2073, 2074,
\space	1721, 1916		2075, 2076, 2077, 2078, 2079, 2081
\StartTime	1919, 1933	\TestMod	1882, 1984, 2418, 2419,
\StopTime	1924, 1936		2420, 2421, 2422, 2423, 2424,
\strip@pt	1916		2425, 2426, 2427, 2428, 2429,
\SummaryTime	1911, 1913, 1926, 1940		2430, 2431, 2432, 2433, 2434,
<b>T</b>			
\temp	1949		2435, 2436, 2437, 2438, 2439,
\Test	1677,		2440, 2441, 2442, 2443, 2444,
	1695, 1748, 1753, 1755, 1758,		2445, 2446, 2447, 2448, 2449,
	1761, 1764, 1767, 1770, 1773,		2450, 2451, 2452, 2453, 2454,
	1776, 1779, 1787, 1790, 1798,		2455, 2456, 2457, 2458, 2459,
	1803, 1811, 1822, 1827, 1838,		2460, 2461, 2462, 2463, 2464,
	1840, 1847, 1849, 1856, 1858,		2465, 2466, 2467, 2468, 2469,
	1865, 1871, 1874, 1877, 1883, 1897		2470, 2471, 2472, 2473, 2474,
\TestAbs	1760,		2475, 2477, 2478, 2479, 2480, 2481
	1968, 2031, 2032, 2033, 2034,	\TestMul	1855,
	2035, 2036, 2037, 2038, 2039,		1979, 2267, 2268, 2269, 2270,
	2040, 2041, 2042, 2043, 2045, 2046		2271, 2272, 2273, 2274, 2275,
\TestAdd	1797, 1975, 2161, 2162,		2276, 2277, 2278, 2279, 2280,
	2163, 2164, 2165, 2166, 2167,		2281, 2282, 2283, 2284, 2285,
	2168, 2169, 2170, 2171, 2172,		2286, 2287, 2288, 2289, 2291, 2292
	2173, 2174, 2175, 2176, 2177,	\TestNum	1757, 1966,
	2178, 2179, 2180, 2181, 2182,		1990, 1991, 1992, 1993, 1994,
	2183, 2184, 2185, 2186, 2188, 2189		1995, 1996, 1997, 1998, 1999,
\TestArg	1741, 1742, 1744, 1745		2000, 2001, 2002, 2003, 2005, 2006
\TestCmp	1772, 1972, 2100, 2101, 2102,	\TestOne	1959, 1966, 1967, 1968,
	2103, 2104, 2105, 2106, 2107,		1969, 1973, 1974, 1977, 1978, 1980
	2108, 2109, 2110, 2111, 2112, 2114	\TestPow	1870, 1982, 2311,
\TestCount	1740, 1744, 1745, 1746		2312, 2313, 2314, 2315, 2316,
\TestDec	1786,		2317, 2318, 2319, 2320, 2321,
	1974, 2148, 2149, 2150, 2151,		2322, 2323, 2324, 2325, 2326,
	2152, 2153, 2154, 2155, 2156, 2157		2327, 2328, 2329, 2330, 2331,
\TestDiv	1873, 1983, 2366, 2367, 2368,		2332, 2333, 2334, 2335, 2336,
	2369, 2370, 2371, 2372, 2373,		2337, 2338, 2339, 2340, 2341,
	2374, 2375, 2376, 2377, 2378,		2342, 2343, 2344, 2345, 2346,
	2379, 2380, 2381, 2382, 2383,		2347, 2348, 2349, 2350, 2351,
	2384, 2385, 2386, 2387, 2388,		2352, 2353, 2354, 2355, 2356,
	2389, 2390, 2391, 2392, 2393,		2357, 2358, 2359, 2360, 2361, 2362
	2394, 2395, 2396, 2397, 2398,	\TestResult	1723, 1749
	2399, 2400, 2401, 2402, 2403,	\TestResultTwoExpansions	1730, 1750
	2404, 2405, 2406, 2407, 2408,	\TestSgn	1763, 1969,
	2409, 2410, 2411, 2412, 2413, 2414		2051, 2052, 2053, 2054, 2055,
\TestDo	1946, 1960, 1963, 1964		2056, 2057, 2058, 2059, 2060,
\TestError	2487, 2496, 2497, 2498,		2061, 2062, 2063, 2064, 2066, 2067
	2499, 2500, 2501, 2502, 2503, 2504	\TestShl	1837, 1977,
\TestExch	1753, 1868		2225, 2226, 2227, 2228, 2229, 2230
\TestFac	1867, 1981, 2119, 2120,	\TestShr	1846,
	2121, 2122, 2123, 2124, 2125,		1978, 2234, 2235, 2236, 2237,
	2126, 2127, 2128, 2129, 2130, 2131		2238, 2239, 2240, 2241, 2242,
			2243, 2244, 2245, 2246, 2247,
			2248, 2249, 2250, 2251, 2252,
			2253, 2254, 2255, 2256, 2257,
			2258, 2259, 2260, 2261, 2262, 2263

<code>\TestSpaceAtEnd</code> . . . . .	1715, 1751	<code>\TMP@EnsureCode</code> . . . . .	59, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77
<code>\TestSqr</code> . . . . .	1864, 1980, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307	<code>\typeout</code> . . . . .	1915
<code>\TestSub</code> . . . . .	1821, 1976, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2219, 2220	<b>U</b>	
<code>\TestTeXDivide</code> . . . . .	1743, 1875	<code>\UNDEFINED</code> . . . . .	1704, 1717, 1725, 1733
<code>\TestTime</code> . . . . .	1912, 1925, 1926, 1927	<code>\usepackage</code> . . . . .	1708, 1710
<code>\TestTwo</code> . . . . .	1962, 1970, 1971, 1972, 1975, 1976, 1979, 1982, 1983, 1984	<b>W</b>	
<code>\the</code> . . . . .	56, 62, 152, 158, 161, 165, 166, 170, 171, 175, 178, 181, 184, 187, 190, 193, 196, 199, 202, 205, 208, 211, 218, 220, 225, 228, 231, 234, 237, 241, 242, 250, 277, 281, 282, 283, 286, 287, 294, 295, 331, 340, 344, 345, 381, 391, 394, 400, 402, 410, 1663, 1746, 1868, 1951, 1956	<code>\write</code> . . . . .	20, 41
<code>\TimeDescription</code> . . . . .	1920, 1923, 1927	<b>X</b>	
		<code>\x</code> . . . . .	8, 10, 12, 19, 23, 25, 40, 45, 52, 606, 609, 1778, 1783, 1789, 1794, 1802, 1808, 1810, 1816, 1826, 1832, 1839, 1844, 1848, 1853, 1857, 1862, 1876, 1896, 1902
		<b>Z</b>	
		<code>\z@</code> . . . . .	141, 306, 313, 356, 363, 562, 563, 582, 1222, 1223, 1241, 1415, 1416, 1424, 1581, 1597, 1641, 1913, 2001, 2021, 2041, 2062, 2078, 2092, 2109