

# The Real Number (iPhone/iPad/iPod touch application)

## Operation manual Ver 1.3.1 (2019/ 2/12)

**At the beginning:** This application is 2 lines display scientific calculator.

This manual excludes items clear for scientific calculator user, and items already mentioned in explanation at iTunes Store.

This manual consists of this app peculiar items and different points for each scientific calculator.

**Attention:** This application is designed to aim operability improvement. Conversely, formula and numeric may be changed by unintentionally touch. Please check by yourself carefully any value, if you use it to practical purpose.

In addition, I have checked about many items about calculation, but cannot guarantee no calculation bug.

I make no warranty and can't respond to claims of any kind of damage.

Because you may need some positive information for this purchase, I put mathematical function accuracy check result on this page bottom. Naturally, I have checked the several times amount of various matter and I made the document of a part for reference.

Please see it if you are interested in.

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(All figures in this manual is iPhone 3.5inch, iOS9.x)

## Mathematical notation

Fundamental key input order is same as general scientific calculator way. Multiplication/division is higher priority than addition/subtraction. Until [=] input, calculation is not executed.

(Key Input)	(Formula)	(Answer)
[2][+][3][×][7][=]	$2 + 3 \times 7 =$	23.
[sin][3][0][=]	$\sin 30 =$	0.5
[8][X <sup>2</sup> ][=]	$8^2 =$	64.

No parenthesis key exists. As parentheses input, execute first the part inside of parentheses. After, input the rest part excluding the part surrounded parentheses.

(Key Input)	(Formula)	(Answer)
[2][+][3][=][×][7][=]	$(2 + 3) \times 7 =$	35.
[2][+][3][=][7][÷][=]	$7 \div (2 + 3) =$	1.4
[2][+][3][=][5][+][7][=][×][=]	$(2 + 3) \times (5 + 7) =$	60.
[7][+][1][1][=][sin][=]	$\sin(7 + 11) =$	0.309016994~
[2][+][3][=][X <sup>2</sup> ][=]	$(2 + 3)^2 =$	25.

Adding parenthesis or not is automatically judged. Parenthesis is not added if calculation order is same.

(Key Input)	(Formula)	(Answer)
[2][+][3][=][7][+][=][+][9][=]	$7 + (2 + 3) + 9 =$	21.

[→] key while displaying calculation result, deletes the last executed operator. And it separates the formula back and forth. (Otherwise, it deletes last 1 operator.)

(Key Input)	(Formula)	(Answer)
[2][+][3][=][5][+][7][=][×][=]	$(2 + 3) \times (5 + 7) =$	60.
[→][÷][=]	$(2 + 3) \div (5 + 7) =$	0.416666667~

“,” is used as a separator in numeric or decimal point (by system setting change).“;” is used as a separator between numerics in [log()] (Logarithm of directed numerical).

(Key Input)	(Formula)	(Answer)
[2nd][log()][5][2nd][;][7][8][1][2][5][=]	$\log(5;78,125) =$	7.

[.] (Decimal point) key works also as the input of start point of recurring decimal.

(Key Input)	(Formula)	(Answer)
[1][.][0][.][7][9][=]	$1.0\overline{79}$	1.079797980~

By [ ]/[ ] (Fraction) key twice, former fraction separator turns to mixed fraction separator.

(Key Input)	(Formula)	(Answer)
[1][ <u> ]/[3][<u> ]/[7][=]</u></u>	$1\frac{3}{7}$	1.428571429~

[° ‘ “] (Degree/Minute/Second) key inputs degree at 1st, minute at 2nd, and second at 3rd.

(Key Input)	(Formula)	(Answer)
[1][° ‘ “][2][° ‘ “][3][.][5][° ‘ “][=]	$1^{\circ}2'3.5''$	$1^{\circ}2'3.5''$

Fraction, square root,  $\pi$  are regarded as part of rational/irrational number, these priorities are higher than the other operator.

(Key Input)	(Formula)	(Answer)
[2][ $\sqrt{\quad}$ ][3][ <u> ]/[7][<math>\div</math>][3][<math>\sqrt{\quad}</math>][5][<u> ]/[5][=]</u></u>	$2\sqrt{3/7} \div 3\sqrt{5/5}$	0.368855557~

Angle function [° ‘ “] (Degree/Minute/Second) [rad] [grade], metric prefix (like kilo) are regarded as part of number, these priorities are higher than the other operator.

(Key Input)	(Formula)	(Answer)
[sin][ $\pi$ ][ <u> ]/[4][2nd][rad][=]</u>	$\sin \pi/4 \text{ rad}$	0.707106781~
[1][.][2][Prefix][k][ $\times$ ][8][5][0][=]	$1.2 \times 850$	1,020,000.

The priority of other functions after numeric (like  $X^2$ ) is higher than 4 rules operator, and lower than the rest operator.

(Key Input)	(Formula)	(Answer)
[sin][3][0][ $X^2$ ][+][cos][3][0][ $X^2$ ][=]	$\sin 30^2 + \cos 30^2$	1.

[+/-] key switches minus sign of input numeric, mantissa and exponential. Distinct order of input is not necessary.

(It switches only exponential minus sign if it is immediately after [e] key.)

(Key Input)	(Formula)	(Answer)
[1][.][2][3][e][8][+/-][+/-][+/-][=]	$-1.23e-8$	-0.000000012~

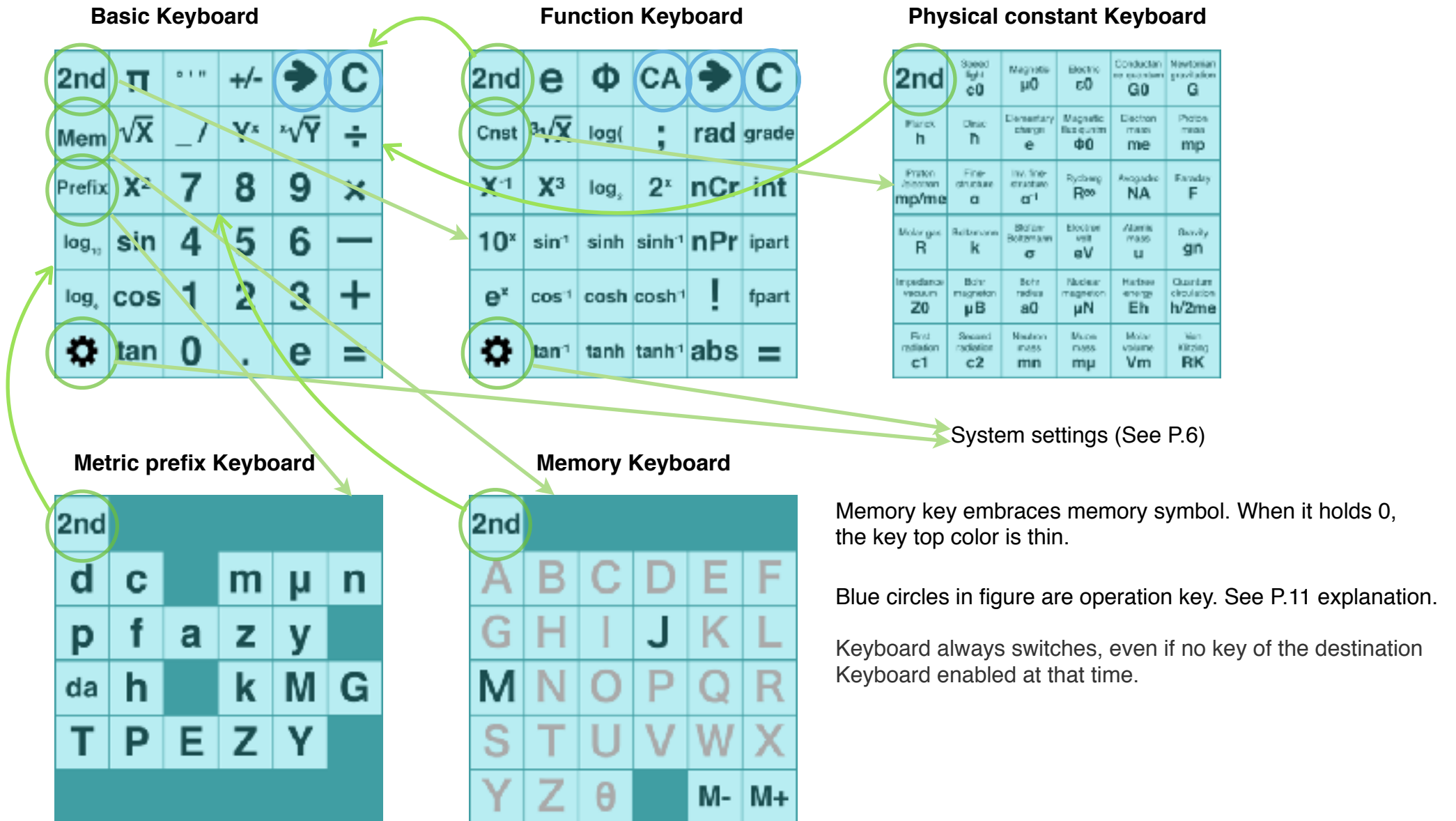
The priority of negative sign is lower than power function and higher than power root.

The reason is I think much of operability, not mathematical consistency. Negative value of power root can be calculated by [+/-][=] after.

(Key Input)	(Formula)	(Answer)
[+/-][5] [X <sup>2</sup> ] [=]	$-5^2=$	-25.
[+/-][3] [Y <sup>x</sup> ] [4] [=]	$-3^4=$	-81.
[+/-][4] [ <sup>x</sup> √Y] [8][1] [=]	$-4^{\sqrt{81}}=$	0.333333333~
[+/-] [=]	$-(-4^{\sqrt{81}})=$	-0.333333333~

# Keyboard

Below 5 Keyboards are switchable. Return to Basic Keyboard after key input is processed.



# System settings



**Decimal part length** of decimal fraction display.

**Rounding rule** of decimal fraction display. (Round down/Round off/Round up)

Display format of **decimal**.  
(Normal/Without exponent/With exponent/With exponent multiple of 3 /Metric prefix multiple of 3/Full metric prefix/Until 16-digits or 34-digits)

Display format of **fraction**. (Improper fraction/Mixed fraction /Decimal fraction/Recurring decimal)

Display format of **recurring decimal**. (Dot/Above bar/Under bar/Paranthesis)

Display format of **irrational number**. (Series/Common denominator)

**Angle types** (DegreeMinuteSecond/Degree decimal/Radian/Gradian).

**Decimal point/separator type**

**Separator location**

- : 1234567890.  
3-3-3 : 1,234,567,890.  
2-2-3 : 1,23,45,67,890.  
4-4-4 : 12,3456,7890.

Blank: default of the unit  
., : 1,234,567,890.  
., : 1.234.567.890,  
. : 1 234 567 890.  
, : 1 234 567 890,  
' : 1'234'567'890.

**Number type** 20 type numerics are available

★**Numeric format switches only when there is no formula (just after reset).**

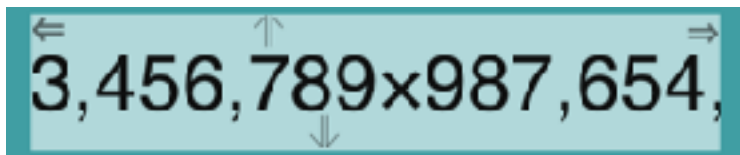
Finish this setting screen and **quit**.

**Reset:** Use it only when you want to initialize this application.

**Reload:** Return to the situation this application starts.

## Formula Display

Upper screen is formula display.



⇐ : It appears when formula head is hidden in left side.

Touch this symbol or touch formula and move right, to see the hidden part.

⇒ : It appears when formula tail is hidden in right side.

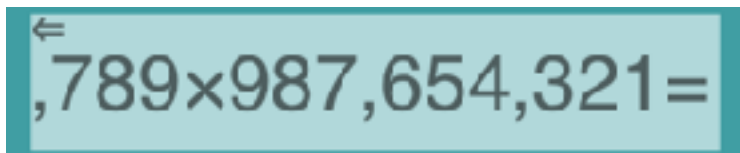
Touch this symbol or touch formula and move left, to see the hidden part.

Previous formulas are automatically saved until 20. These can be seen by below method.

⇑ : It appears when there is a formula before displaying formula. Touch this symbol or touch formula and move down, to see the formula.

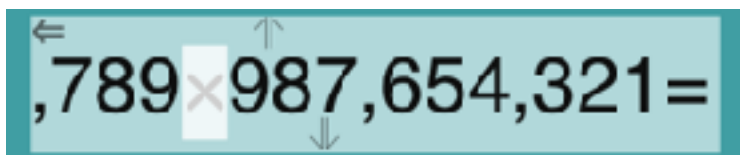
⇓ : It appears when there is a formula after displaying formula. Touch this symbol or touch formula and move up, to see the formula.

These symbols does not appear in the middle of formula input.



By the touch of '=' or blank right side of formula, formula becomes thin color. It is copy mode.

- By memory key touch in the mode, formula is stored in the memory.
- By Formula Display touch in other calculator in the mode, the formula is copied to other calculator.
- By the same formula touch again, formula is copied in pasteboard.
- By the touch when no formula is displayed, formula in pasteboard is recalled. (If line feed is included in string, no operation.)



You can direct where you want to change by the touch in formula. Cursor appears. No cursor appears if the place is impossible to change.

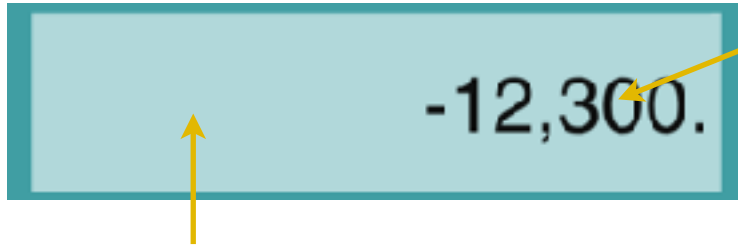
- By [=] key at cursor mode, the displayed formula order shifts after the latest.
- By operator key when cursor stays on operator, operator in formula is modified. If the kind of operator is different between cursor and key, it is no operation.

- When cursor stays on numeric, the numeric under cursor is shown in Numeric Display below. By its modification and [=] key, the numeric in formula is modified.
- By cursor touch, cursor disappears and return to previous situation.



## Numeric Display

Lower screen is Numeric Display. Numeric inputted or modified is displayed. Modification of numeric by direct touch is possible.



**On numeric**, each digit can be modified by direct touch. The behavior varies by handling after.

**Leave without move** : +1(-9).

**Move up** : +2(-8). Do +1(-9) by continuous move.

**Move down** : -1(+9). Do -1(+9) by continuous move.

**Move right** : Delete 1digit right of it.

**Move left** : Insert 0 right of it.

**In blank**, below functions are attached to touch action.

**Move up** : Add 1 in front of highest digit.

**Move down** : Switch plus and minus.

**Move right** : Delete last 1digit 0. Or decimal point location shifts to left. (Integer/decimal fraction only)

**Move left** : Insert 1 digit '0' last. Or decimal point location shifts to right.(Integer/decimal fraction only)

**Leave without move** : Numeric becomes thin color. It is copy mode.

- By memory key touch in the mode, numeric is stored in the memory.
- By Numeric Display touch in other calculator in the mode, the numeric is copied to other calculator.
- By the same numeric touch again, numeric is copied in pasteboard.  
(If line feed is included in string, no operation.)

Input guidance is displayed by thin color before numeric entering. Numeric can be inputted only by touch action.



**On leftmost digit** touch, numeric can be inputted. The behavior varies by handling after.

**Leave without move** : Input 1 to the digit.

**Move up** : Input 2 to the digit. Do +1 by continuous move.

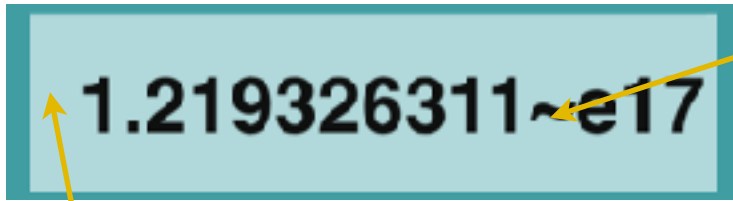
**Move down** : Input 9 to the digit. Do -1 by continuous move.

**Move right** : Input 7 to the digit.

**Move left** : Input 4 to the digit.

**In blank**, touch and leave without move : Numeric in pasteboard is recalled.

Calculation result, value in memory, constant are displayed by thick letter. Modification by touch is impossible.



1.219326311~e17

When displayed number is rounded, '~' mark is added to mantissa.

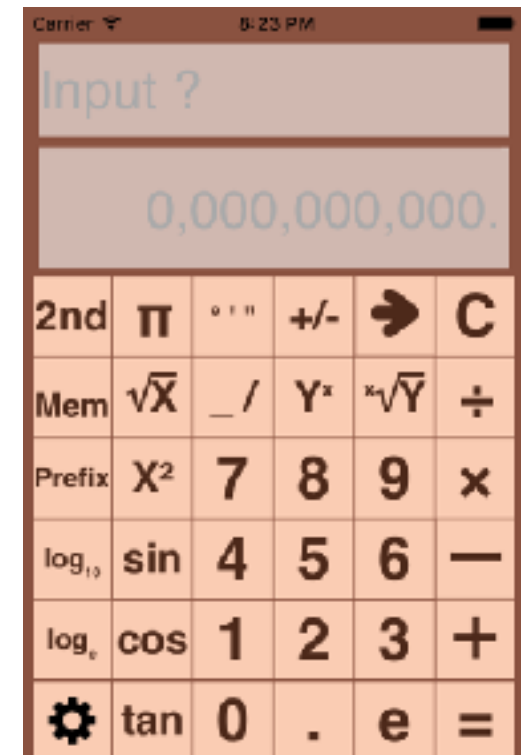
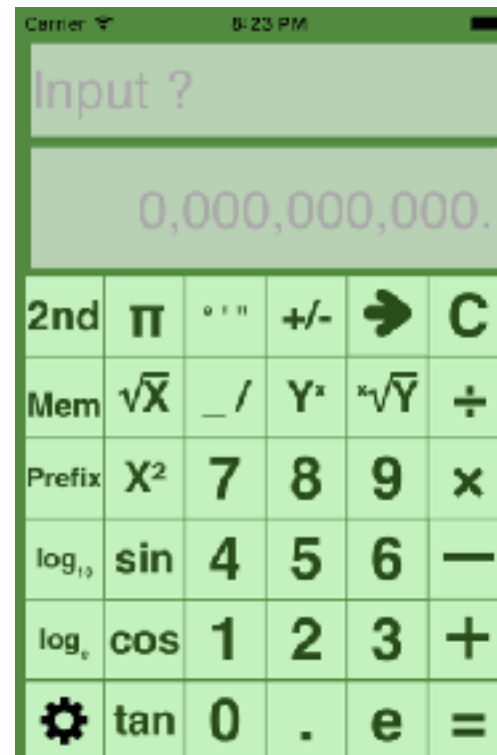
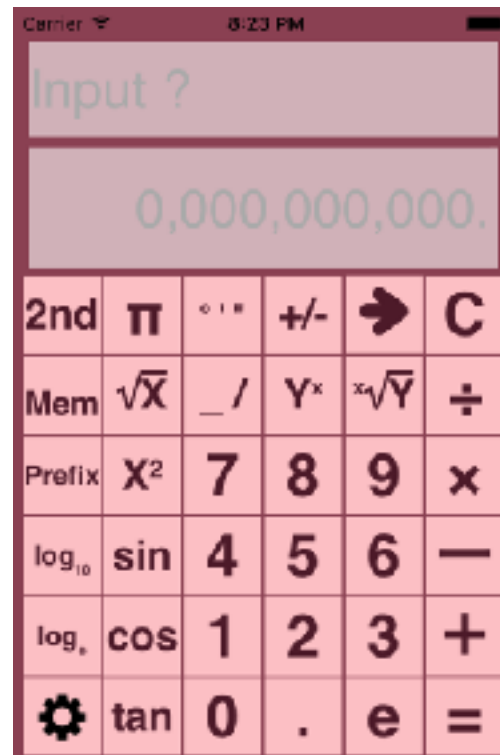
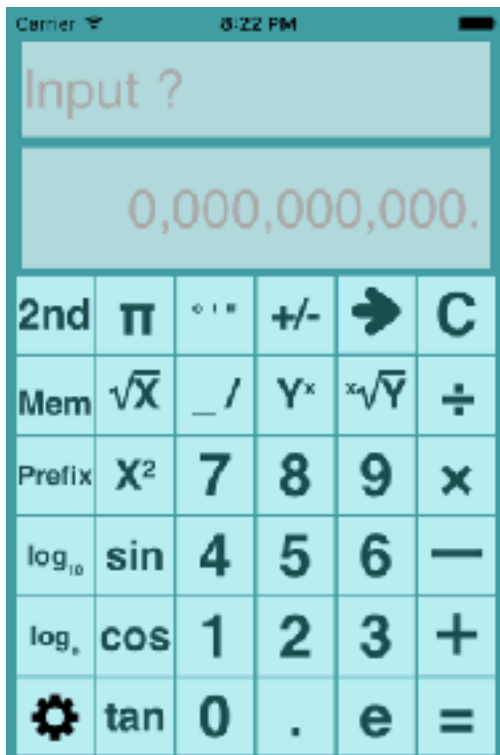
You can distinguish accurate value or not.

**In blank**, touch and leave without move : Numeric becomes thin color. It is copy mode.

- Memory key is pressed in the mode, numeric is stored in the memory.
- By Numeric Display touch in other calculator in the mode, the numeric is copied to other calculator.
- By the same numeric touch again, numeric is copied in pasteboard.

## Sheet

There are 4 same operation scientific calculators.



To the touch in back dark color area, below functions are attached.

**Move right or left** : Switch to other scientific calculator.

**Leave without move** : The balloon of copy/paste formula is displayed when these are available. Select aimed operation from it.

- By copy choice, formula is stored in pasteboard. You can paste it into another application like E-mail, or other calculator.
- By paste choice, formula in pasteboard is recalled to the calculator.

## **Key**

This page explanation omits keys obvious to scientific calculator user, obvious from key top name, unnecessary to normal user, and already explained previous pages.

There are explanations only for items I think necessary. Unique function of this calculator and not common thing by scientific calculator difference.

**[C]** : It clears numeric display only, when numeric is inputted. Otherwise, it clears formula display.

**[→]** : It deletes 1 last digit, when numeric is inputted. Or it deletes 1 last function in formula, when formula is inputted. Otherwise, it separates formula back and forth. (P.4) If it is touched in error state, it releases error, holding formula.

**[CA]** : It deletes past whole stored formula. Please notice to touch it and store necessary formula to memory before this operation. It doesn't clear other 3 calculators.

**[Φ]** : Golden number

**[nCr]** : Combinations

**[nPr]** : Permutations

**[int]** : Round to integer (Rounding way follows P.6 settings)

**[ipart]** : Cut to integer part only

**[fpart]** : Cut to decimal fraction part only

**[abs]** : Absolute value

**Memory key** : It stores value or formula to memory by memory key touch in copy mode(, after numeric or formula touch).

If memory content is not 0, key top color of memory becomes dark.

When memory holds numeric and memory key is touched, memory name is appended last of formula.

When memory holds formula and memory key is touched in the situation displayed formula blank, the memory formula is recalled.

- \* [+] [−] [Y<sup>x</sup>] key function and memory uses fullwidth character in formula string. Please notice it when you make or modify formula outside of this app and use it through pasteboard.
- \* Constant keys contain values of CODATA2014. Weight unit is 'kg'. So when you calculate weight using these constants and display with SI prefix, SI prefix in result is wrong unless you revise by ×1000. Please note it.  
I decided this specification because if I change the constant to adjust, other units result with SI prefix becomes wrong.

## **Error**

In calculation, below error may occur occasionally. Please correct it by reference with below error message explanation.  
[→] key releases error without erasing formula.

**Syntax error** : There is a mistake in formula input.

**Calculation is not defined** : The case like division by 0. No clear calculation definition exists.

**Over the range** : When calculation result exponential part is equal to 100 or over.

**Under the range** : When calculation result exponential part is equal to -100 or under.

(It becomes 0 in general scientific calculator. This app differs from it.)

**Stack size over** : This app equips 25 function and 16 numeric stack. Error occurs when calculation can't process in this size.

**Number type is different** : When numeric type differs to function input. (For example, DegMinSec is used to not angle function)

**Out of the function range** : Numeric of function input exceeds the range this app can treat. (Factorial, Permutations, Combinations)

If error message differs from above, this app should be abnormal situation.

I appreciate if you inform me the detailed situation by E-mail address shown on the site this manual is placed.

In error situation, cursor appears at the location where error is detected. Please take care that error detected location and the location you should revise agree rarely. And, cursor disappears when error detected location is formula end.

- Formula maximum size of this app is 512 bytes.

For example, [sin] function is memorized by 's' 'i' 'n' 3bytes. Fullwidth 1 character uses 2 ~ 4bytes.

So maximum function amount in one formula is less than it. The reason is I think such large size is not necessary in practical use.

I appreciate if you inform me the detailed situation if you need more.

- When your input formula exceed the maximum size, no error occurs. Input is only ignored.

The reason is I think it rarely occurs in real operation by above reason.

## **Modification history**

### **Modifications → Ver1.1.0**

- Modified the priority relation between power, power root and negative sign to make fewer key operation in practical use.
- Fixed a bug that prefix function could not be modified to square root.
- Fixed a bug that [+/-][=] operation and deletion of negative sign in formula didn't work.
- Fixed a bug of number display after  $\wedge^{-1}$ ,  $\wedge^3$ , !.
- Fixed a bug of [M+] [M-] key operation fault.
- Fixed a bug of int( error.
- Fixed a bug of combination between rad, grade and Prefix.
- Fixed a bug negative sign of "minus value  $\wedge$  large number".

### **Modifications → Ver1.2.0**

- Improvement of the function calculation accuracy.
- Pattern increase of the fraction result or exact result of function calculation.
- At the paste, make no operation if line feed is included.
- Other detailed operability unification.

### **Modifications → Ver1.3**

- Fixed bugs of some recurring decimal number display problems.
- Fixed bugs those key inputs like 'π rad' are not able.
- Fixed a bug of pico unavailable touch modification.
- Fixed a bug some kind formula memory recall doesn't work.
- Correction of +/- reverse key motion in exponent part.
- Erase copy/paste balloon by a key touch.
- Delete twitter button because iOS11 or after doesn't support it.
- iPhoneX/XR/XS display.

### **Modifications → Ver1.3.1**

- Fixed a bug of wrong result display at EXACT mode when the exponent is 100 or more.
- Fixed a bug of wrong result display when exchanging memory or constant.
- Made available the exchange between memory and constant.
- Changed to no operation the [⇒] key delete operation of parenthesis. (To avoid error)