

The Real Number (Application for Android 6.0 or over)

Operation manual Ver. 1.0 (2020/ 5/25)

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

This manual excludes items clear for scientific calculator user and consists of this app peculiar items and different points from normal scientific calculator.

Attention: Please check by yourself carefully any value, if you use it to practical purpose.

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

I put mathematical function accuracy check result on this page bottom as check example. Naturally, I have checked the several times amount of various matters. The document is a part of these for reference.

I have developed and checked this application with Visual studio/Xamarin/Android emulator and confirmed actual unit operation only with Android 9.0. I follow rule of Android, and I have corresponded and checked different screen resolution, so I believes it works on any models without a problem, but I can't guarantee. If you encounter this application's trouble, I wish you to inform me it with as much as possible detailed information like equipment specs, etc.

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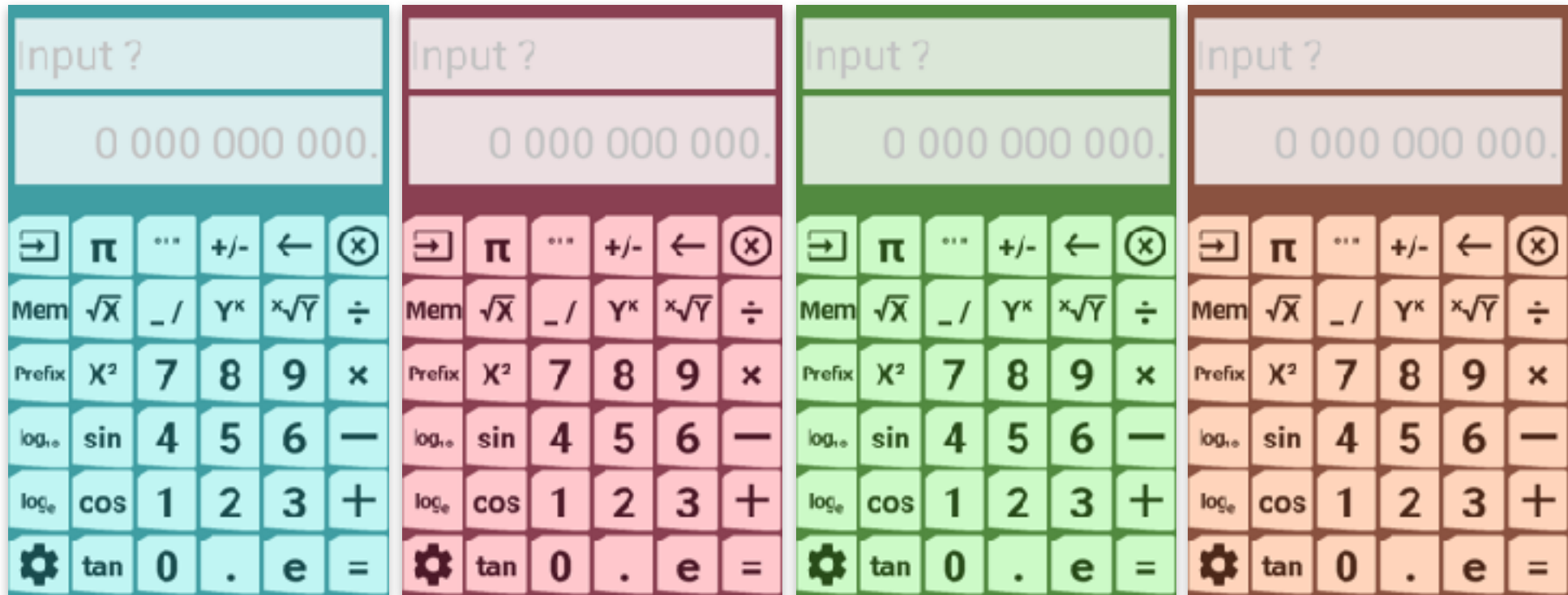
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Sheet

This application is scientific calculator.



There are 4 just same operation scientific calculator sheets. For multiple use purpose, each sheet wears different color.

By scrolling right or left (Touch dark color behind and move right or left), you can switch to another sheet.

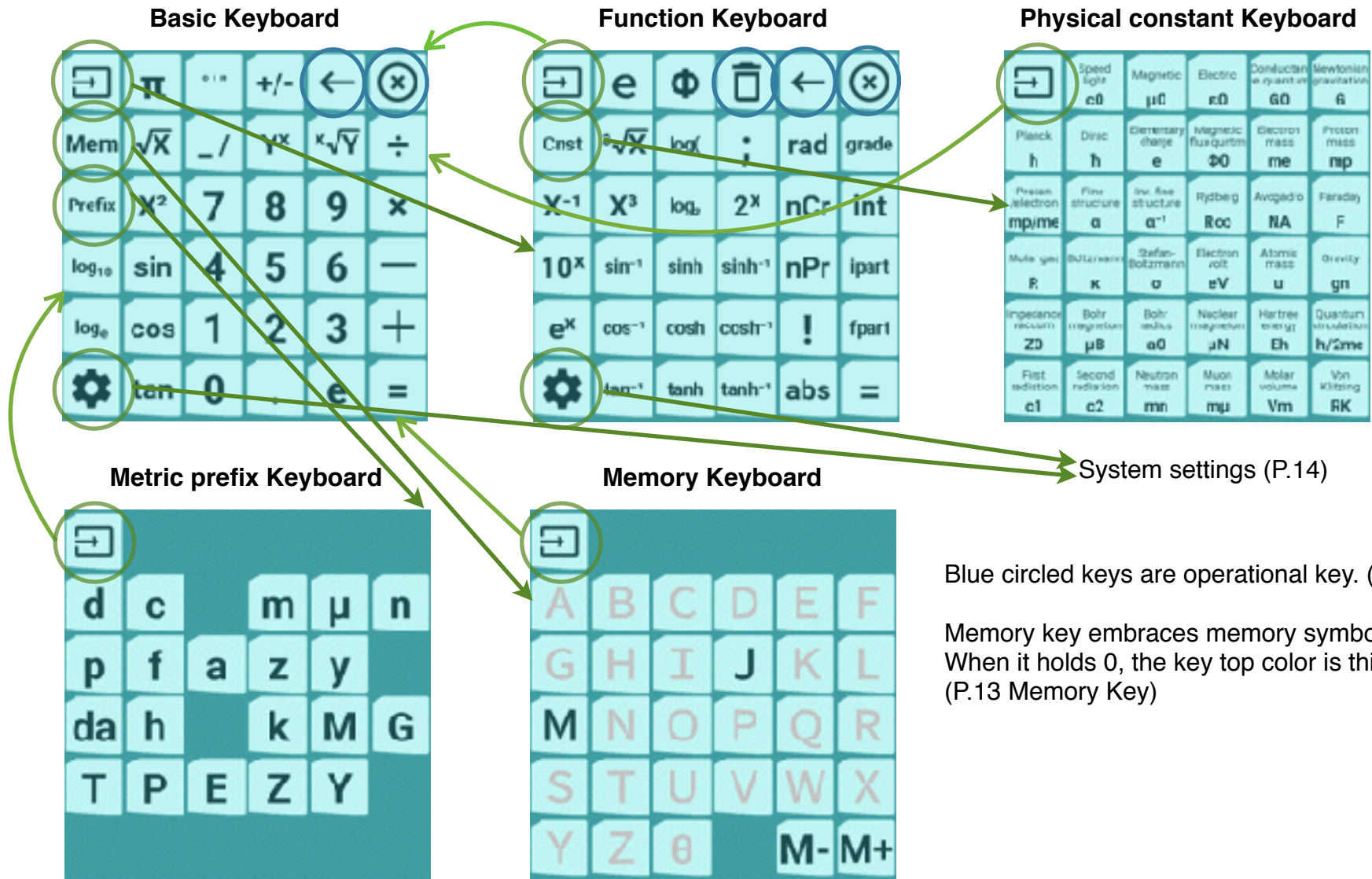
Display separates 2 lines. Formula and Numeric, each display equips different touch function.

Depending on window size, following items are set up.

Display length 10-digits or 14-digits, 1 sheet or 2 sheets pair, and vertical or horizontal.

Keyboard

Each sheet equips below 5 keyboards. And switchable by green circled keys. It always switches regardless of input state. The sheet returns to Basic Keyboard after key input is processed.



Blue circled keys are operational key. (P.13)

Memory key embraces memory symbol. When it holds 0, the key top color is thin. (P.13 Memory Key)

Entering formula

Fundamental key input order is same as general scientific calculator way. Multiplication/division is higher priority than addition/subtraction. Enter [sin] etc. before the numerical as in the formula expression. 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 ²][=] | $8^2 =$ | 64. |

No parenthesis key exists. As parentheses input, execute first the part inside of parentheses. After, execute the rest part excluding the part surrounded parentheses. Formula with parenthesis is automatically generated by executing calculations following in the calculation execution order.

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

| (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][=] | $\sin(7 + 11) =$ | 0.309 016 994~ |
| [2][+][3][=][X ²][=] | $(2 + 3)^2 =$ | 25. |
| [2][+][3][=][7][+][=][+][9][=] | $7 + (2 + 3) + 9 =$ | 21. |

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

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

| (Key Input) | (Formula) | (Answer) |
|--------------------------------------|--------------|-----------------|
| [1][.][2][3][e][8][+/-][+/-][+/-][=] | $-1.23e-8 =$ | -0.000 000 012~ |

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

| (Key Input) | (Formula) | (Answer) |
|-----------------------|----------------------|----------------|
| [1][.][0][.][7][9][=] | $1.0\overline{79} =$ | 1.079 797 980~ |

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

| (Key Input) | (Formula) | (Answer) |
|------------------------|------------------|----------------|
| [1][_ /][3][_ /][7][=] | $1\frac{3}{7} =$ | 1.428 571 429~ |


[° ‘ “](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, [π] are regarded as part of rational/irrational number, these priorities are higher than the other operator.

| (Key Input) | (Formula) | (Answer) |
|--|---------------------------------|-----------------------|
| [2][√][3][_ /][7][÷][3][√][5][_ /][5][=] | $2\sqrt{3}/7 \div 3\sqrt{5}/5=$ | $0.368\ 855\ 557\sim$ |

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

| (Key Input) | (Formula) | (Answer) |
|--|-------------------------|-----------------------|
| [sin][π][_ /][4][ <td>$\sin\pi/4\text{rad}=$</td> <td>$0.707\ 106\ 781\sim$</td> | $\sin\pi/4\text{rad}=$ | $0.707\ 106\ 781\sim$ |
| [8][4][0][÷][1][.][2][Prefix][k][=] | $840 \div 1.2\text{k}=$ | 0.7 |

Other than above, the priority of operators after numeric (like X^2) is higher than arithmetic operators, and lower than the operators before numeric.

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



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

The reason is that I place much value operability than mathematical consistency.

Negative value of power root can be calculated by [+/-][=] after.

| (Key Input) | (Formula) | (Answer) |
|---------------------------------|----------------------|------------------------|
| [+/-][5][X ²][=] | $-5^2=$ | $-25.$ |
| [+/-][3][Y ^x][4][=] | $-3^4=$ | $-81.$ |
| [+/-][4][x√Y][8][1][=] | $-4^{\sqrt{81}}=$ | $0.333\ 333\ 333\sim$ |
| [+/-][=] | $-(-4^{\sqrt{81}})=$ | $-0.333\ 333\ 333\sim$ |

“;” is used as a separator between numerics in [log()] (Logarithm of specified numerical). “,” is used as a separator in numeric or decimal point (by system setting P.14).

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

This manual omits remaining functions explanation, because these are obvious to scientific calculator user from key top name. Only the keys that are not commonly provided are shown below.

[**nCr**] : Combinations

[**nPr**] : Permutations

[**!**] : Factorial

[**int**] : Round to integer

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

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

[**abs**] : Absolute value

Following two constants, 35 physical constants, and memory (when number is stored) can be used in the formula instead of number.

[**e**] : Napier's constant (base of natural logarithm) [Full-width characters on Function Keyboard]

[**Φ**] : Golden number

* Physical constant keys contain values of CODATA2018. Weight unit is 'kg' as definition. So when you calculate weight using these, result display metric prefix does not agree unless you revise by $\times 1000$.
If adjusting these values to weight unit 'g', when you calculate value besides weight using these, result display metric prefix becomes wrong vice versa. So record values are fixed. Please note it.

Formula Display

Upper square displays formula inputting or executed. Previous formulas are automatically memorized until 20 in each sheet separately. Arrow symbols express formula status.

⇐ : It appears when formula is displayed from the middle.

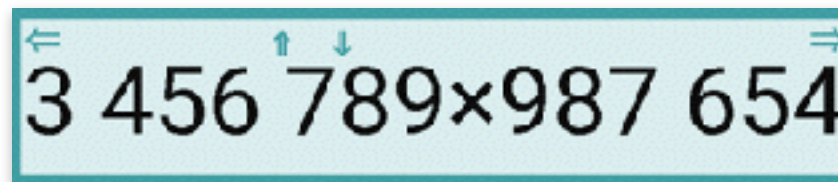
⇒ : It appears when displayed formula is cut halfway.

⇑ : It appears when there is a formula before displayed formula.

⇓ : It appears when there is a formula after displayed formula.

By touching an arrow symbol, the display range of formula shifts to the arrow direction.

Or by touching formula and move Up/Down/Right/Left, the display range of formula shifts to the inverse direction.

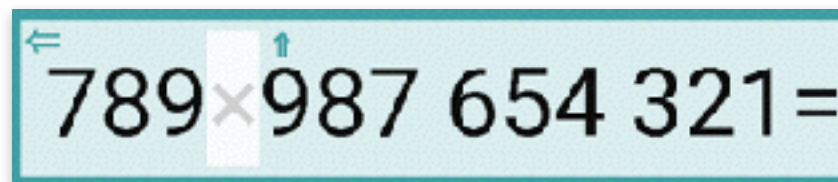


Cursor appears when you touch where you want to modify in formula. No cursor appears if the function in the place is impossible to modify.

By the touch of '=' or blank right side of formula, the formula becomes copy mode. (Next page)

When cursor exists on operator, memory, or physical constant, pressing of same kind key modifies it. If the kind is different between cursor and key, it is no operation.

When cursor is over a numeric, the numeric under cursor is copied in below Numeric Display. By its modification and [=] key, the numeric in formula is modified.



By [=] key at cursor state, the displayed formula order shifts after the latest formula. Modified formula of above case shifts after the latest, too.

By cursor touch, cursor disappears and return to previous situation. Formula order is held.

By the touch and release of '=' or after, formula becomes copy mode.
Whole formula color becomes thin.

This formula is copied to next touched item.

- By memory key touch in the mode, formula is stored in the memory.
(P.13 memory Key)
- By touch of other calculator's Formula Display in the mode, the formula is pasted to.
- By the same formula touch again, formula is stored in clipboard.

Input guidance is displayed by thin color before formula entering.

- By memory key touch in the state when the memory holds formula, the formula is recalled here.

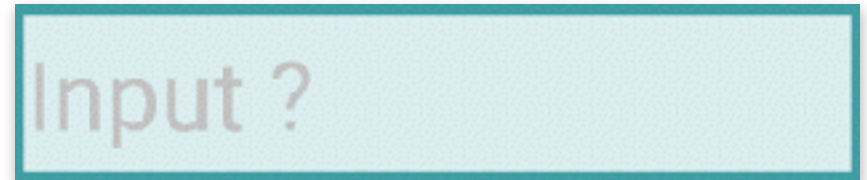
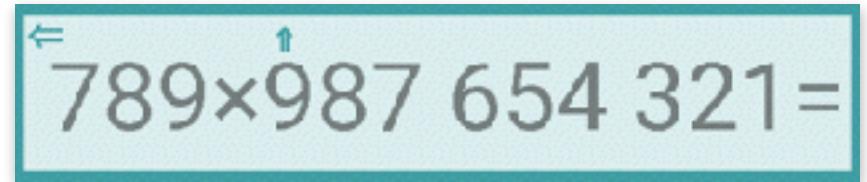
At below case, formula is pasted by the touch and release here.

- When another calculator's Formula Display is copy mode, the formula is pasted in here.
- When clipboard holds formula, the formula is recalled here.
(If line feed is included in clipboard string, it is no operation.)

- Clipboard content is common with other apps. This app can use formulas in clipboard created or modified by external app. When you need complex modification to formula or want to save formula in file, please use your accustomed editor. This app is designed to simplify such operation command on the premise that it is convenient to users.

However, it has different point from general applications. Function like [—] [Y*] and memory are allocated fullwidth character.

Please notice it when you intend to create formula in external editor.



- **Clipboard operation command**

You can copy whole memorized formulas in the sheet to clipboard at the same time.

You can also paste from clipboard.

And there is calculation command that calculates clipboard formulas and appends the results after each formula in clipboard.

By touch and release in dark color area back of the sheet, context menu appears. Select aimed operation from it. It doesn't appear in the middle of inputting formula or numerical. Also, the selector is not displayed, when the command does not work.

Paste command skips wrong formula that causes an error. Calculation command appends error message after formula, and inserts cursor to the error location in formula. Please correct error by reference of that.

- To tell the truth, clipboard formula calculation command processes a lot of functions those aren't shown on keyboard. I cut those from next 2 points. Operability, and impossibility of test all. The function list is put in "Nugget RealNumberCalculator" document in my manual storage. If you are necessary more detailed explanation, please inform me. I will respond something such as how to use it.

- Formula maximum size of this app is 512 bytes(UTF-8 code).

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

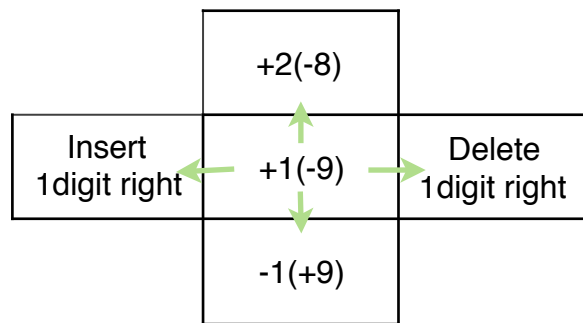
So maximum function amount included in one formula is less than it.



Numeric Display

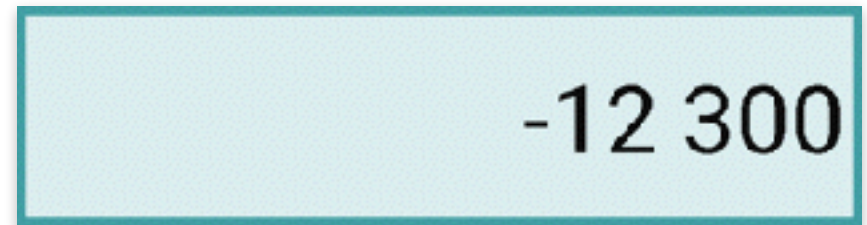
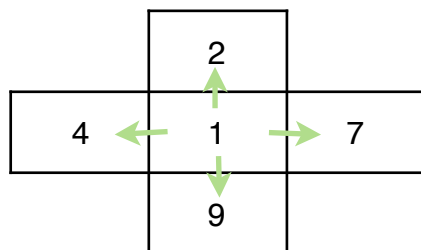
Lower square is Numeric Display. Numeric inputting or modifying is displayed. Modification of numeric by direct touch is possible. The motion differs depending on whether on blank or on number, and following action. (Release without move/Up/Down/Right/Left) Operate slowly. Stop a moment after touching and then move.

On number, below left table operations work. Only when moving up or down, continuous operation works for adjusting the value.

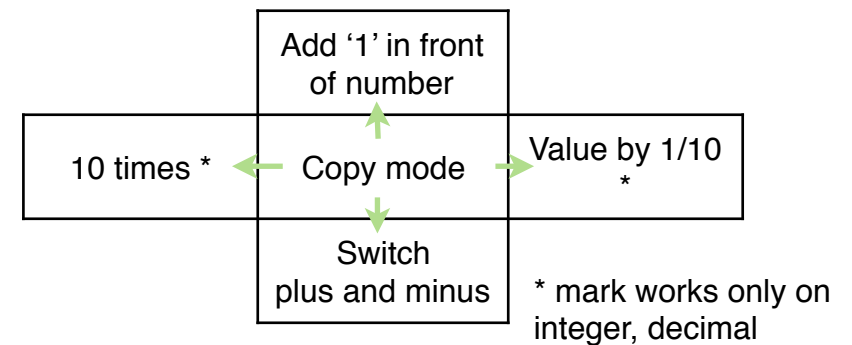


Input guidance is displayed by thin color before numeric entering. Numeric also can be inputted by touch action.

Touch the guidance most significant digit of number you want to input. The digit changes to below table number depending on following action. (Release without move/Up/Down/Right/Left)



On blank, below right table operations work.



Calculation result is displayed here by thick letter.
Physical constant and recalled value from memory are displayed by thick letter, too.
Modification by touch is impossible.

Internal calculations are performed with decimal/fraction/part of irrational number, and results are accurate if calculations are within the displayed digits.

When displayed number is rounded, '~' mark is added to mantissa.
You can distinguish the result is accurate value or not.

By the touch and release on blank before numeric or thick letter numeric, it becomes copy mode. Whole numeric color becomes thin.

- By memory key touch in the mode, the value is stored in the memory. (P.13 Memory Key)
- By touch of other calculator's Numeric Display in the mode, the numeric is pasted to. (Only when the aimed Numeric Display is blank)
- By the same numeric touch again, numeric is stored in clipboard.

When input guidance is displayed at below case, numeric is pasted by the touch and release here.

- When another calculator's Numeric Display is copy mode, the numeric is pasted here.
- When clipboard holds numeric, the numeric is recalled here.



1.219 326 311~e17



1.219 326 311~e17



0 000 000 000.

Operational Key



When calculation result is displayed, it clears Formula and Numeric Display. Memorized formulas are kept. In the middle of input, when numeric is inputted, it clears Numeric Display. Otherwise, it clears Formula Display. As a prevention of calculation loss by miss touch, it doesn't work by short touch.



It deletes whole past memorized formula. Other 3 calculators' formulas are kept. As a prevention of calculation loss by miss touch, it doesn't work by short touch. Please store necessary formula to memory or save to text file through clipboard before this operation.



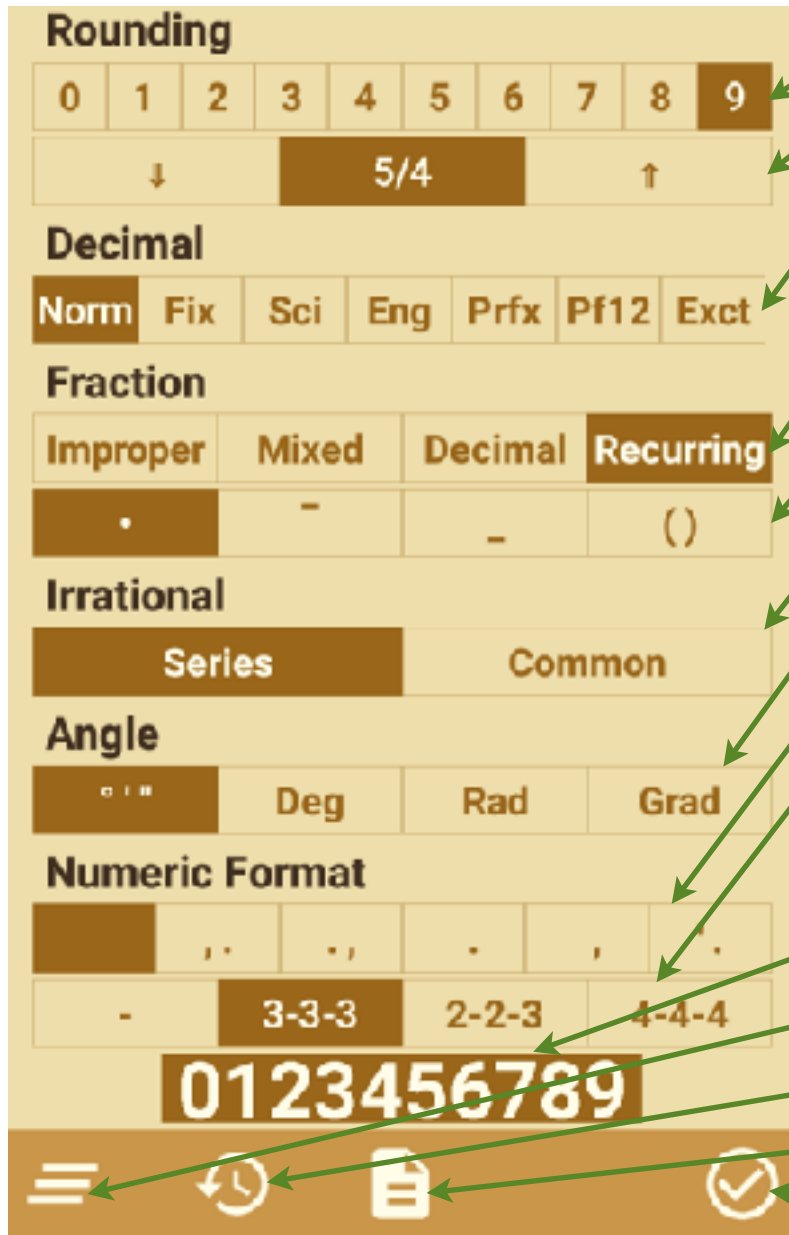
It deletes 1 last digit, when numeric is inputted. Or it deletes 1 last function in formula, when formula is inputted. When displaying calculation result, deletes the last executed operator. And it separates the formula back and forth. If it is touched in error state, it releases error, holding formula.

| (Key Input) | (Formula) | (Answer) |
|----------------------------------|------------------------|----------------|
| [2][+][3][=] [5][+][7][=] [×][=] | $(2+3) \times (5+7) =$ | 60. |
| [←] | $5+7=$ | 12. |
| [÷][=] | $(2+3) \div (5+7) =$ | 0.416 666 667~ |

Memory key

- 4 sheets share the same memory. The same value is held in the same letter memory of every sheet.
- To store value or formula to memory, set numeric or formula to copy mode by touching, and press memory key.
- When the memory holds formula and it is touched in the situation Formula Display blank, the formula is recalled. When the memory holds numeric and it is touched, memory letter is appended last of formula.
- Clear key doesn't affect memories. To clear memory, store 0 to the memory.

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/Expand 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/Parenthesis)

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

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

Decimal point/separator type

Blank: default of the unit

Separator location (Also decimal part)

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

,. : 1,234,567,890.
,. : 1.234.567.890,
. : 1 234 567 890.
, : 1 234 567 890,
' : 1'234'567'890.

Number type 19 type numerics are available

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

Reload the situation this application started. It doesn't work by short touch.

Show this manual. (The reload situation is updated.)

Finish this setting screen and **quit**.

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

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.

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

Over the range : When calculation result exponent is equal to 100 or over.

Under the range : When calculation result exponent is equal to -100 or under.

(This app differs from general scientific calculator that shows 0 in the case.)

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. (For example, DegMinSec is used to no 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.

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

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

The reason is I think it seldom occurs in practical operation.

Modification history