IZ1242M

Scientific 10 Digits LCD Calculator

IZ1242M

The IZ1242M is the CMOS LSI for 10-digit display and the complete single chip for scientific calculator with 56 programmed functions.

FUNCTIONS

- **Six operations**
  - four standard functions (+, -, ×, ÷)
  - y^x
  - $\sqrt{y}$
  - auto-constant
  - parenthesis
  - percentage
- **Memory calculation**
  - independent single memory ($\times \rightarrow$ M, RM, M+)
- **Four operations complex number calculation**
- **1-variable functions**
- trigonometric and arctrigonometric function
- hyperbolic and archyperbolic function
- factorial
- reciprocal and square
- square root and cube root
- time conversions
- angular mode conversion
- **2-variable functions**
  - polar-rectangular coordinate conversion
- **Statistics calculations**
- number of sample (n)
- average ($\times$)
- total of all data ($\Sigma \times$)
- total of square of all data (Σx^2)
- 2 kinds of the standard deviation (S, σ)
- **Binary, octal, decimal and hexadecimal number**
   calculations
- mutual conversions and calculations of binary, octal,
  decimal, and hexadecimal numbers
- **Display conversion**
  - conversion and setting of floating and engineering displays

FEATURES

- **Display**
  - 10 display digits plus negative code digit
  - scientific and engineering displays
- 8 mantissa digits plus 2 exponent digits plus 2 negative code digits
- **14 kinds of special display**

M	Memory	**GRAD**	Gradient
-	Minus	**( )**	Parenthesis
E	Error	**BIN**	Binary mode
2ndF	2nd	**OCT**	Octal mode
HYP	Function	**HEX**	Hexadecimal
DEG	Hyperbolic	**CPLX**	mode
	Degree		Complex number
RAD		**STAT**	mode
	Radian		Statistic
			calculation mode

- The minus sign of the mantissa is floating minus
- The arithmetic key operation has the same sequence
  as the mathematical equation, 6 pending operations
  are allowed and ( ) are up to continuous 15 levels
- Mutual conversion and calculation in arithmetic among binary, octal, decimal and hexadecimal numbers
- One independent accumulating memory
- It is possible to convert and fix the display number
  system by the **F → E** key
- It is possible to specify decimal part digits by the **TAB** key
- Direct drive for LCD (1/3 prebias, 1/4 duty)
- Automatic power off (about 7.5 minutes)
- Low power consumption
  V_{DD} = 3.0V single power supply
- Bare chip available
- Mirror type

ABSOLUTE MAXIMUM RATINGS ($T_a = 25^oC$)

Characteristic	Symbol	Value	Unit
Terminal Voltage	V_{DD}	- 0.3 ~ + 3.3	V
	V_{IN}	- 0.3 ~ V_{DD} + 0.3	V
Operating Temperature	T_{opr}	0 ~ + 40	^oC
Storage Temperature	T_{stg}	- 55 ~ + 125	^oC

* Voltage greater than above may damage the circuit

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ELECTRICAL CHARACTERISTICS (T_a = 25°C, V_{DD} = 3.0V, V_{SS} = 0V unless otherwise specified)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
Operating Voltage	V_{DD}		2.5	3	3.4	V
Input Voltage (K18 ~ K11)	V_{IH}		V_{DD} - 0.5		V_{DD}	V
	V_{IL}		V_{SS}		V_{SS}+0.5	
High Output Voltage (K18, K14, K12)	V_{OH}		V_{DD} - 0.2	V_{DD}	V_{DD}	V
Output Voltage (LCD, COM)	V_{OH}		V_{DD} -0.2	V_{DD}	V_{DD}	V
	V_{OL}		V_{SS}	V_{SS}	V_{SS} +0.2	
Low Output Voltage (K11)	V_{OL}		V_{SS}	V_{SS}	0.2	V
Middle Output Voltage (LCD, COM)	V_{OM}		2/3V_{DD} -0.2	2/3V_{DD}	2/3V_{DD} +0.2	V
			1/3V_{DD} -0.2	1/3V_{DD}	1/3V_{DD} +0.2	
Key Pull Down Resistance (K11)	R_{pd}	V_{out} = 0V	30	50	70	KΩ
Key Pull Up Resistance (K18, K14, K12)	R_{pu}	V_{out} V_{DD}	30	50	70	KΩ
OSC Frequency	F_{dis}	Stand-by V_{DD} = 3V	30	45		KHz
	F_{opr}	Operating V_{DD} = 3V		200	280	
Frame Frequency	F_f	Stand-by V_{DD} = 3V	110	180		Hz
Supply Current	I_{OFF}	Display is off V_{DD} = 3V		1	3	µA
	I_{DIS}	Stand-by V_{DD} = 3V		20	35	
	I_{OPR}	Operation V_{DD} = 3V		70	120	

BASIC SPECIFICATION
Number of display digits
• 10-digit display and 14 kinds of special displays
• Engineering display
• Max mantissa 8 digits plus exponent 2 digits plus each negative code digit
• Normal display
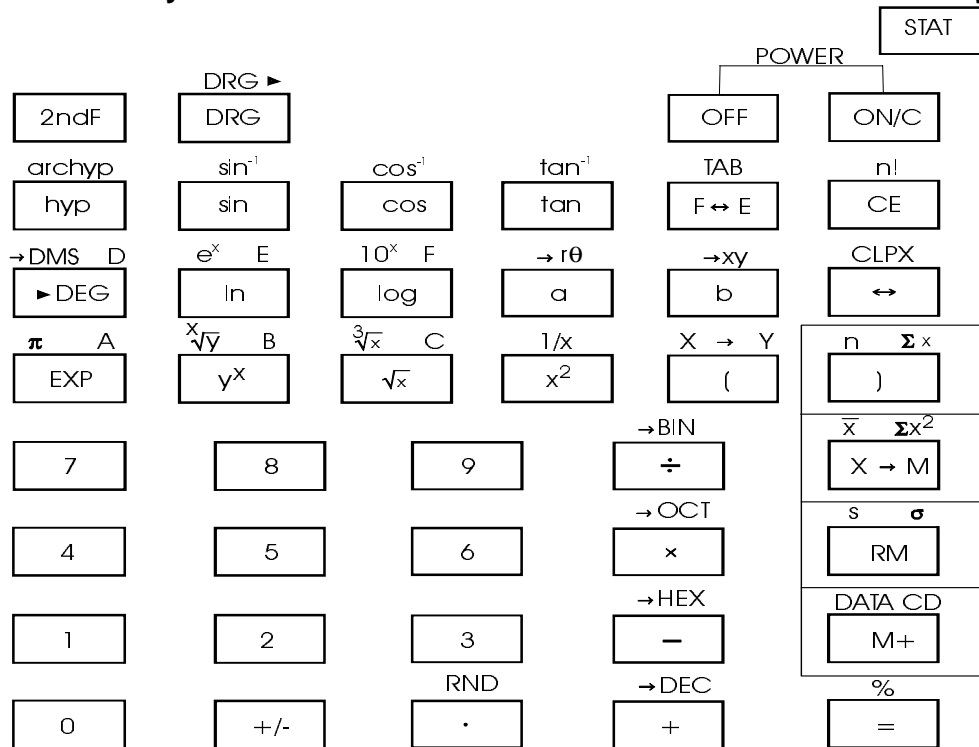Max 10 mantissa digits plus 1 negative code 6 digit.
It is possible to specify the number of 0 to 9 digits below the decimal place by assignment of the decimal digit.
Classification of operating mode
The following 6 types of operation mode are set by the 2ndF key and below keys:

   2ndF   STAT   : Statistic calculation mode set
   2ndF   CLPX   : Complex number calculation
                        mode set
   2ndF   - BIN   : Binary mode set
   2ndF   - OCT   : Octal mode set
   2ndF   - HEX   : Hexadecimal mode set
   2ndF   - DEC   : Decimal mode set

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Kinds of keys and classification of the multi-functions for all touch keys

	DRG ►			POWER	STAT
2ndF	DRG			OFF	ON/C
archyp	sin⁻¹	cos⁻¹	tan⁻¹	TAB	n!
hyp	sin	cos	tan	F↔E	CE
→DMS D	eˣ E	10ˣ F	→ rθ	→xy	CLPX
►DEG	ln	log	a	b	↔
π A	$^x\sqrt{y}$ B	$\sqrt[3]{x}$ C	1/x	X → Y	n Σx
EXP	yˣ	√x	x²	(	)
			→BIN		x̄ Σx²
7	8	9	÷		X → M
			→OCT		s σ
4	5	6	×		RM
			→HEX		DATA CD
1	2	3	−		M+
		RND	→DEC		%
0	+/-	·	+		=

The condition during calculation
No key input is allowed and no data is displayed during calculation.

Display method
a.   Set number and result of operation are displayed in the right margin, minus floating.
b.   Display of decimal number operation results.
Display is made according to the display format that has been set by the F ↔ E key.

• Floating mode

$$10^{10} \leq |x| \leq 10^{100}$$: Exponent display
$$10^{-99} \leq |x| \leq 10^{-9}$$: Exponent display
0 and $10^{-9} \leq |x| \leq 10^{10}$: Floating display

• Engineering mode

0 and $10^{-99} \leq |x| \leq 10^{100}$ (all ranges); Exponent display.
The F ↔ E key also converts the display format of a displayed numerical value simultaneously with the display format setting.
At the same time, the number of digits below the decimal point of the above modes follows the display format assigned by the 2ndF and F ↔ E keys.
Further, in the same manner as the F ↔ E key, the conversion is also takes place simultaneously with the display format setting.

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When the number of digits is specified, the last digit displayed is a rounded number, and when there is no specification of the number of digits, the last digit displayed is a cut number.

Example:

| 2 | ÷ | 7 | = | 0.285714285 |

| 2ndF | TAB F↔E | 3 | 0.286 |

| F↔E | 2.857-01 |

| 2ndF | TAB F↔E | · | 2.8571428-01 |

c.   Negative numbers are not displayed with the minus symbol "-" but are displayed in hexadecimal, octal, and binary two's complements.

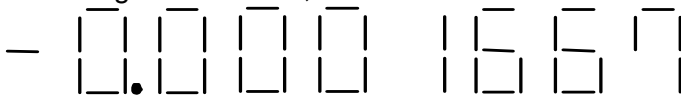d.   Display style and special display
  • Display style

  • Special display
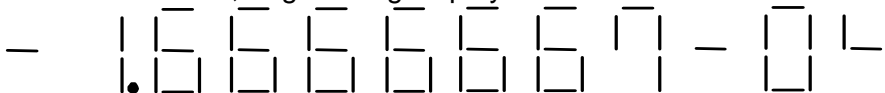
STAT CPLX HEX OCT BIN ( ) GRAD RAD DEG DEG HYP 2ndF

e.   Examples of display
  • Floating of –6000 1/x; TAB=7

  • Same as above, engineering display

  • Error display

Protection

a.   Memory overflow protection
  If the overflow occurs in the memory calculation, the data before the calculation is retained.

b.   Statistical overflow protection
  If the overflow occurs in the statistical calculation, the data before the calculation is retained.
  The number of digits of the internal retained data.

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The number of digits of the mantissa of the displayed data is a maximum of 10 digits, but the available data for successive calculations is the retained data.

The number of digits of the mantissa of the internally retained data is as follows:

Data input	Maximum	10 digits
Arithmetic	Maximum	10 digits
Engineering function.		
Statistical function		
Complex number function		
Memory calculation.	Maximum	3 digits
Number of random		

Auto clear

When the power supply is suddenly turned on an auto clear routine is executed to initialize as DEC mode, no TAB, floating and DEG modes.

Power off function

a.   Auto power off

About 7.5 minutes after operation is ended by pressing the key, the power supply is turned off.

b.   OFF

Pressing this key will stop the oscillator (Memory safe guard).

c.   ON

Pressing this key will wake the oscillator and initialize

OPERATION MODE
Operational mode

Operation	Mode	DEC	*BIN*	OCT	HEX	STAT	CPLX
6 Operation	4 Operation +, -, ×, ÷, =	0	0	0	0	0	0
	Power y^x, $^x\sqrt{y}$	0	x	x	x	0	x
	Parenthesis ( )	0	0	0	0	x	x
	Constant calculation	0	0	0	0	0	x
	Percentage calculation	0	x	x	x	0	x
STAT	Statistical calculation	x	x	x	x	0	x
CLPX	CLPX calculation	x	x	x	x	x	0
	Input a, b	0	x	x	x	x	0
DATA setting	Numeric input 0, 1	0	0	0	0	0	0
	Numeric input (2 – 7)	0	x	0	0	0	0
	Numeric input 8, 9	0	x	x	0	0	0
	Hex input A – F	x	x	x	0	x	x
	• , Exp	0	x	x	x	0	0
	+/-	0	0	0	0	0	0
	Shift key	0	0	0	0	0	0
CE		0	0	0	0	0	0
Memory	Memory calculation	0	0	0	0	0	0
Display conversion	F ← E, TAB	0	x	x	x	x	x
P – R conversion	P → R → P	0	x	x	x	x	0
Random	RND	0	x	x	x	0	0
Function	1 variable function	0	x	x	x	0	0
Angular conversion	DRG, DRG ▶	0	x	x	x	0	0

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The calculation is always shifted to a specified mode by mode keys

A Mode   B Mode

| A B	DEC	BIN	*OCT*	*HEX*	STAT	CPLX
DEC	NOP	DEC Conversion	DEC Conversion	DEC Conversion	DEC Conversion State clear	DEC Conversion State clear
BIN	BIN Conversion	NOP	BIN Conversion	BIN Conversion	BIN Conversion State clear	BIN Conversion State clear
OCT	OCT Conversion	OCT Conversion	NOP	OCT Conversion	OCT Conversion State clear	OCT Conversion State clear
HEX	HEX Conversion	HEX Conversion	HEX Conversion	NOP	HEX Conversion State clear	HEX Conversion State clear
STAT	Display Clear	Display Clear	Display Clear	Display Clear	NOP	Display Clear
CPLX	Display Clear	Display Clear	Display Clear	Display Clear	Display Clear State clear	NOP

NOP: No operation

KEY DEFINITIONS

1.   2ndF
This is the key for specifying the second function.
When this key is pressed, the special display «2ndF» lights. When this key is pressed twice the second function mode is released.

2.   DRG   DRG

a.   Pressing this key will change the mode of angle sequentially
and display it.

$$\rightarrow \text{DE} \longrightarrow \text{RA} \longrightarrow \text{GRAD}$$
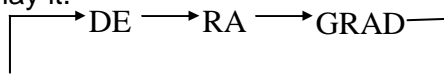
b.   Pressing this key after 2ndF key will change the mode of the angle and will convert the displayed data.

DEG $\rightarrow$ RAD   : RAD = DEG $\times \pi/180$
RAD $\rightarrow$: GRAD = RAD $\times 200/\pi$
GRAD
GRAD $\rightarrow$ DEG   : DEG = GRAD $\times 0.9$

3.   0 – 9
a.   In setting data in the mantissa section, it is set at the right margin, and the data in more than 11 digits cannot be input.
b.   At the data input against the exponent, the last two numbers are efficients.

4.   ● RND

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a.   The position first pressed has preference, and no input is made to data set in the exponent section.

b.   When pressed as the first set number, it is regarded as 0 and • keys are pressed.

c.   Random as a 2ndF.

Pressing this key shall display the random numbers.

The range of random numbers is 0.000 – 0.999.

5.   +/-

a.   In setting data in the mantissa section, this key reverses the code in the mantissa section.

Similarly, for the exponent section, it reverses the code in the exponent section.

b.   For the operation result, this key reverse codes in the mantissa section.

6.   + , - , ×, ÷, =, ( )

a.   When the key operations are performed by these keys according to a numerical expression, a result of the operation is obtained according to mathematical priorities, priorities discriminated are:

1) 1 Variable function

2) Expression in ( ): (The most inner expression has priority in case of multiple parentheses)

3) y^x , $^x\sqrt{y}$

4) ×, ÷

5) +, -

b.   Whenever the key is operated, the calculator discriminates the above priorities and holds the data and operation keys pending as required.

This pending action is possible up to 6 times and 7 or more pending become error.

c.   (Key is accepted only immediately after CE, +, -, ×, ÷, y^x, $^x\sqrt{y}$, =, (keys and not accepted in all other cases.

When this key is accepted, the displayed data is cleared to 0.

When (key is first accepted, the special display « ( ) » illuminates.

When a parenthesis expression is completed) and = keys or when it is cleared by the ON/C key, etc, or when errors are generated, the special display « ( ) » goes out.

d.   If it is within the allowable range of pending. (can be input into any place in an expression as many times as desired. However, if the key is pressed continuously 16 times or more, it be comes error.

e.   From a viewpoint of numerical expression, even when the corresponding C key is not pressed, the operation is not executed if the «)» key is pressed. On the other hand, when the «(« key is pressed and the «=» key is pressed without pressing the corresponding «)» key, the operation is also completed according to the priority.

7.   Memory calculation (x → M, RM, M+)

a.   The memory register «M» used by these keys is a completely independent single memory.

b.   Display data is added to «M» (memory register) by M+ key.

If data overflows at this time, the processing data is held.

c.   Display data is stored in «M» by x → M key.

d.   Contents of «M» is displayed by MR key.

e.   When any data except for 0 is stored in «M», the special display «M» illuminates.

8.   π

a.   This key displays a rounded value (3.141592654) of a 12-digit value (3.14159265359) according to the set display format.

b.   A value that is used in a subsequent operation is the above the 12-digit value.

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c.   The display is cleared by the following 1-st numeric key and new data is set.

9. % Calculation.

a.   When any arithmetic functions or constant mode has/not been set, the displayed number is converted from a percentage to a decimal.

Example) 61.5%

Display

6   1 .   5   %   0.615

b.   When = key is pressed after % with any arithmetic function

- • Add-on

  a + b   %   =   →a + (a   x   a   y^x b   %   =   →a^t (t = b/100)
                        b)/100

- • Discount   a $^x\sqrt{y}$ %   =   → $^t\sqrt{a}$ (t   =

  a - b   %   =   →a -   (a   x   b   b/100)
                        b)/100

- •

  Percentag   %   =   →(a x b)/100
  e

  a x b

   a ÷ b   %   =   →a/b x 100

10. Trigonometric and arctrigonometric functions (1 Variable).
(sin, cos, tan, sin^{-1}, cos^{-1}, tan^{-1})

These functions are calculated according to respective defined areas and accuracy show in (6), and displayed result of operation can become operators.

11. Hyperbolic and archiperbolic function.
(hyp → sin cos tan, archyp → sin cos tan)

Same as trigonometric function.

12. Exponential and logarithmic functions.
(e^x 10^x ln log)

Same as trigonometric functions.

13. Reciprocal, square, square root and cube root.
(1/x x^2 $\sqrt{}$ $^3\sqrt{}$)

Same as trigonometric functions.

14. Factorial functions (n!).

n! = n x (n-1) x (n-2) x … x 2 x 1

Same as trigonometric functions.

15. →DEG → DMS

a.   These keys convert degrees, minutes and seconds into decimal degrees and decimal degrees into degree minutes and seconds.

b.   On the DMS format, the integer part of display data is regarded as degrees, 2 digits below the decimal point as minutes and the 3rd digit and below as seconds.

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1.999999999 -DMS	1 degree	59 minute	5999 second

16. **Coordinate conversion (a b → r θ → xy).**

a.   These keys convert the rectangular coordinates into the polar coordinates and the polar coordinates into the rectangular coordinates. The angle units that have been set by the **DRG** key follows.

b.   Respective defined areas and accuracy are as shown in (6), however, the range of θ obtained by **R→P** in degree is as follows:

1st	Quadrant	$0^o \leq \theta \leq 90^o$
2nd	Quadrant	$90^o \leq \theta \leq 180^o$
3rd	Quadrant	$-180^o \leq \theta \leq -90^o$
4th	Quadrant	$-90^o \leq \theta \leq 0^o$

c.   Input of 2 variables is performed by setting

X or **R** by pressing **a** key and

Y or θ by pressing **b** key

d.   The operation result of **X** or **R** is obtained in the display register or by pressing **a** key and **Y** or θ by pressing **b** key.

	Input Data		Result	
	a	**b**	**a**	**b**
R→P (Rectangular→Polar)	x	y	r	θ
P→R (Polar→Rectangular)	r	θ	x	y

(→r, θ) r = $\sqrt{(x^2 + y^2)}$, θ =$\tan^{-1}$ y/x

(→x, y) x = r cosθ, y = r sinθ

e.   (R → P Conversion) ([x, y] →[r, θ])   f.   (P → R Conversion) ([r, θ] → [x, y])

Key operation	Display	Key operation	Display
x	x	θ	θ
a	x	b	θ
y	y	r	r
b	y	a	r
→r θ	r	→xy	x
b	θ	b	y

17. Binary Mode (2ndF , → BIN, 0, 1).

a.   Data input and output are both binary integers in a maximum of 10 digits.

b.   A negative number is expressed in the binary number of two's complement.

c.   The range of internal operation is as show below and if the result of the operation exceed the range, it becomes an error (overflow).

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	Binary Number	Decimal Number
Outside the operation range	-	512 ≤ DATA
Binary Positive Integer	1 1 1 1 1 1 1 1 1	511
	1 1 1 1 1 1 1 1 0	510
	1 1 1 1 1 1 1 0 1	509
	:	:
	:	:
	10	2
	1	1
	0	0
Binary Positive Integer (Complement)	1 1 1 1 1 1 1 1 1	-1
	1 1 1 1 1 1 1 1 0	-2
	1 1 1 1 1 1 1 0 1	-3
	: :	:
	: :	:
	1 0 0 0 0 0 0 0 0 1	-511
	1 0 0 0 0 0 0 0 0 0	-512
Outside the operation range		-512 ≥ DATA

18. Octal Mode (2ndF , → OCT, 0 - 7)
a.   Data input and output are both octal integers with a maximum of 10 digits.
b.   A negative number is expressed in the octal number of two's complement.
c.   The range of internal operation is as show below and if the result of the operation exceed the range, it becomes an error (overflow).

	Octal Number	Decimal Number
Outside the operation range	-	5 3 6 8 7 0 9 1 2 ≤ DATA
Binary Positive Integer	3 7 7 7 7 7 7 7 7 7	5 3 6 8 7 0 9 1 1
	3 7 7 7 7 7 7 7 7 6	5 3 6 8 7 0 9 1 0
	:	:
	:	:
	1	1
	0	0
Octal Negative Integer (Complement)	7 7 7 7 7 7 7 7 7	-1
	7 7 7 7 7 7 7 7 6	-2
	1 1 1 1 1 1 1 0 1	
	: :	:
	: :	:
	4 0 0 0 0 0 0 0 0 1	-5 3 6 8 7 0 9 1 1
	4 0 0 0 0 0 0 0 0 0	-5 3 6 8 7 0 9 1 2
Outside the operation range		-5 3 6 8 7 0 9 1 3 ≥DATA

19. Hexadecimal Mode (2ndF , → HEX, 0 – 9, A - F).
a.   Data input and output are both hexadecimal integers with a maximum of 10 digits.
b.   A negative number is expressed in the hexadecimal number of two's complement.
c.   The range of internal operation is as show below and if the result of the operation exceed the range, it becomes an error (overflow).

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	Hexadecimal Number	Decimal Number
Outside the operation range	-	$1 \times 10^{10} \leq$ DATA
Hexadecimal Positive Integer	2 5 4 0 B E 3 F F	9 9 9 9 9 9 9 9 9
	2 5 4 0 B E 3 F E	9 9 9 9 9 9 9 9 8
	:	:
	:	:
	1	1
	0	0
Hexadecimal Negative Integer (Complement)	F F F F F F F F F F	-1
	F F F F F F F F F E	-2
	:	:
	:	:
	F D A B F 4 1 C 0 2	-9 9 9 9 9 9 9 9 8
	F D A B F 4 1 C 0 1	-9 9 9 9 9 9 9 9 9
Outside the operation range		$-1 \times 10^{10} \geq$ DATA

20. Complex number Mode (2ndF , → CPLX).

a.   Pressing these keys shall set the complex number mode.

b.   Input of 2 parts is performed by setting the real part (X; Pressing a key) and the imaginary part (Y; pressing b key).

c.   The operation result of the real part is obtained by pressing = or **a** key and the imaginary part by pressing **b** key.

Characteristic	Input Data 1		Function	Input Data 2		Result	
	Real	Imaginary		Real	Imaginary	Real	Imaginary
	a	b		a	b	a	b
Addition	X1	Y1	+	X2	Y2	X1+X2	Y1+Y2
Subtraction	X1	Y1	-	X2	Y2	X1-X2	Y1-Y2
Multiplication	X1	Y1	×	X2	Y2	X1X2-Y1Y2	Y1X2+X1Y2
Division	X1	Y1	÷	X2	Y2	$\dfrac{X1X2+Y1Y2}{X2^2+Y2^2}$	$\dfrac{Y1X2-X1Y2}{X2^2+Y2^2}$

21. Static calculation Mode (2ndF , STAT).

a.   Pressing these keys shall set the static calculation mode.

b.   The available number of data is a positive integer, such as $0 \leq n \leq 9999999999$, and when the number of data exceeds this integer, it becomes an error.

c.   The input range of the data is as follows: $0 \leq |$ data $| \leq 1 \times 10^{50}$.
This data exceeds the ranges, it becomes an error.

d.   n   Σx   Σx^2

These keys display the number of data (sample), each sum total of **x** and sum total of **x^2**.

$$\bullet \text{ Average; } X = \frac{\sum\limits_{i=1}^{n} x_i}{n} = \frac{\Sigma x}{n}$$

$$S = \sqrt{\frac{\sum\limits_{i=1}^{n} (xi\text{-}x)^2}{n^{-1}}} = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/n}{n^{-1}}}$$

• The standard deviation of the sample

$$\delta = \sqrt{\frac{\sum\limits_{i=1}^{n} (xi\text{-}x)^2}{n}} = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/n}{n}}$$

• The standard deviation of the population

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ERROR CONDITIONS

1. The result of operation is exponent parts exceed + 99
2. Entering more than the calculation range (6) of each function.
3. Dividing be zero.
4. In statistical calculation.
a.   x, s, σ when n=0
b.   s when n=1
5. The number of pending operations exceeds 3.
6. The number of the parenthesis in the one level exceeds 15.

OPERATION RANGE AND ACCURACY

Function	Angle Unit	Operation Range	Under Flow Area	Normal Accuracy
sin x	DEG	$0 \le |x| \le 4.499999999 \times 10^{10}$	$0 \le |x| \le 5.729577951 \times 10^{-98}$	
	RAD	$0 \le |x| \le 7853981633$	—	
	GRAD	$0 \le |x| \le 4.999999999 \times 10^{10}$	$0 \le |x| \le 6.366197723 \times 10^{-98}$	
cos x	DEG	$0 \le |x| \le 4.500000008 \times 10^{10}$	—	
	RAD	$0 \le |x| \le 7853981649$	—	
	GRAD	$0 \le |x| \le 5.000000009 \times 10^{10}$	—	
tan x	DEG	$0 \le |x| \le 4.499999999 \times 10^{10}$	$0 \le |x| \le 5.729577951 \times 10^{-98}$	
	RAD	$0 \le |x| \le 7853981633$	—	
	GRAD	$0 \le |x| \le 4.999999999 \times 10^{10}$	$0 \le |x| \le 6.366197723 \times 10^{-98}$	
$\sin^{-1}x$	DEG	$0 \le |x| \le 1$	$0 \le |x| \le 1.570796326 \times 10^{-99}$	10 digits ± 1
	RAD	$0 \le |x| \le 1$	—	
	GRAD	$0 \le |x| \le 1$	$0 \le |x| \le 1.570796326 \times 10^{-99}$	
$\cos^{-1}x$	DEG	$0 \le |x| \le 1$	—	
	RAD	$0 \le |x| \le 1$	—	
	GRAD	$0 \le |x| \le 1$	—	
$\tan^{-1}x$	DEG	$0 \le |x| \le 9.999999999 \times 10^{99}$	$0 \le |x| \le 1.570796326 \times 10^{-99}$	
	RAD	$0 \le |x| \le 9.999999999 \times 10^{99}$	—	
	GRAD	$0 \le |x| \le 9.999999999 \times 10^{99}$	$0 \le |x| \le 1.570796326 \times 10^{-99}$	
ln x		$0 \le x$	—	
log x		$0 \le x$	—	
e^x		$-9.999999999 \times 10^{99} \le x \le 230.2585092$	$-9.999999999 \times 10^{99} \le x \le 227.9559243$	

◩ INTEGRAL

OPERATION RANGE AND ACCURACY *(Continued)*

Function	Operation Range	Under Flow Area	Normal Accuracy
10^x	$-9.999999999 \times 10^{99} \leq x \leq 99.99999999$	$-9.999999999 \times 10^{99} \leq x \leq 99.00000001$	
$x!$	$0 \leq x \leq 69$ (integer)	—	
$1/x$	$1 \times 10^{-99} \leq |x| \leq 9.999999999 \times 10^{99}$	$1.000000001 \times 10^{99} \leq |x| \leq 9.999999999 \times 10^{99}$	
x^2	$0 \leq |x| \leq 9.999999999 \times 10^{49}$	$0 \leq |x| \leq 3.162277660 \times 10^{-50}$	
$\sqrt{x}$	$0 \leq |x| \leq 9.999999999 \times 10^{99}$	—	
$\sqrt[3]{x}$	$0 \leq |x| \leq 9.999999999 \times 10^{99}$	—	
DMS→DEG	$0 \leq |x| \leq 9.999999999 \times 10^{9}$	—	
DEG→DMS	$0 \leq |x| \leq 9.999999999 \times 10^{9}$	$0 \leq |x| \leq 2.777777777 \times 10^{-99}$	
sinh x	$0 \leq |x| \leq 230.2585092$	—	
cosh x	$0 \leq |x| \leq 230.2585092$	—	
tanh x	$0 \leq |x| \leq 9.999999999 \times 10^{99}$	—	
$\sinh^{-1} x$	$0 \leq |x| \leq 4.999999999 \times 10^{99}$	—	
$\cosh^{-1} x$	$1 \leq x \leq 4.999999999 \times 10^{99}$	—	
$\tanh^{-1} x$	$0 \leq |x| \leq 9.999999999 \times 10^{-1}$	—	10 digits ± 1
R→P (x, y) (r, θ)	$|x|, |y| \leq 9.999999999 \times 10^{49}$ $(x^2 + y^2) \leq 9.999999999 \times 10^{99}$	correspond to the under flow area of tan x	
P→R (r, θ) (x, y)	$0 \leq r \leq 9.999999999 \times 10^{99}$ θ correspond to the under flow area of sin x, cos x	θ correspond to the under flow area of sin x, cos x	
DEG→RAD	$0 \leq |x| \leq 9.999999999 \times 10^{99}$	$0 \leq |x| \leq 5.729577951 \times 10^{98}$	
RAD→GRAD	$0 \leq |x| \leq 1.570796326 \times 10^{98}$	—	
GRAD→DEG	$0 \leq |x| \leq 9.999999999 \times 10^{99}$	$0 \leq |x| \leq 1.111111111 \times 10^{-99}$	
y^x	$-9.999999999 \times 10^{99} \leq x, \ln|y| \leq 230.2585092$ y > 0; The above – mentioned operation range y < 0; x (integer) or 1/x (x = odd, x = 0) The above – mentioned operation range y = 0; x > 0.	$-9.999999999 \times 10^{99} \leq x, \ln|y| \leq -227.9559243$	
$\sqrt[x]{y}$	$-9.999999999 \times 10^{99} \leq 1/x, \ln|y| \leq 230.2585092$ y > 0; The above – mentioned operation range y < 0; x (odd) or 1/x (integer, x ≠ 0) The above – mentioned operation range y = 0; x > 0.	$-9.999999999 \times 10^{99} \leq 1/x, \ln|y| \leq -227.9559243$	
→DEC	The following operation range after the conversion. $0 \leq |x| \leq 9999999999$		—
→BIN	The following operation range after the conversion. $1000000000 \leq x \leq 1111111111, \ 0 \leq x \leq 1111111111$		—
→OCT	The following operation range after the conversion. $4000000000 \leq x \leq 7777777777, \ 0 \leq x \leq 3777777777$		
→HEX	The following operation range after the conversion. $FDABF41C01 \leq x \leq FFFFFFFFFF, \ 0 \leq x \leq 2540BE3FF$		—

INTEGRAL

IZ1242M

OPERATION RANGE AND ACCURACY (Continued)

| Function	Operation Range	Under Flow Area	Normal Accuracy
Complex number calculation	$(X1+Y1i)$ +, -, $\times$, $\div$ $(X2+Y2i)$ Addition and subtraction $\lvert X1+X2 \rvert \leq 9.999999999 \times 10^{99}$ $\lvert Y1+Y2 \rvert \leq 9.999999999 \times 10^{99}$ Multiplication $\lvert X1X2-Y1Y2 \rvert \leq 9.999999999 \times 10^{99}$ $\lvert Y1X2+X1Y2 \rvert \leq 9.999999999 \times 10^{99}$ $\lvert X1X2 \rvert, \lvert Y1Y2 \rvert, \lvert Y1X2 \rvert, \lvert X1Y2 \rvert \leq 9.999999999 \times 10^{99}$ Division $\dfrac{X1X2+Y1Y2}{X2^2+Y2^2}$, $\left\lvert \dfrac{Y1X2-X1Y2}{X2^2+Y2^2} \right\rvert \leq 9.999999999 \times 10^{99}$ $\lvert X1X2 \rvert, \lvert Y1Y2 \rvert, \lvert Y1X2 \rvert, \lvert X1Y2 \rvert, \lvert X2^2+Y2^2 \rvert, \lvert X2^2 \rvert, \lvert Y2^2 \rvert,$ $\lvert X1X2+Y1Y2 \rvert, \lvert Y1X2-X1Y2 \rvert \leq 9.999999999 \times 10^{99}$		10 digits ± 1
Statistic calculation	Data; $\lvert x \rvert \leq 9.999999999 \times 10$ $\lvert \sum x \rvert \leq 9.999999999 \times 10$ $\lvert \sum x^2 \rvert \leq 9.999999999 \times 10$ x; n = 0 s; n = 1, n = 0 $0 \leq (\sum x^2 - (\sum x)^2/n)/ n^{-1} \leq 9.999999999 \times 10$ σ; $n \neq 0$ $0 \leq (\sum x^2 - (\sum x)^2/n)/ n \leq 9.999999999 \times 10$		10 digits ± 1

LCD CONNECTION

. **Segment**

b. Common

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INTEGRAL
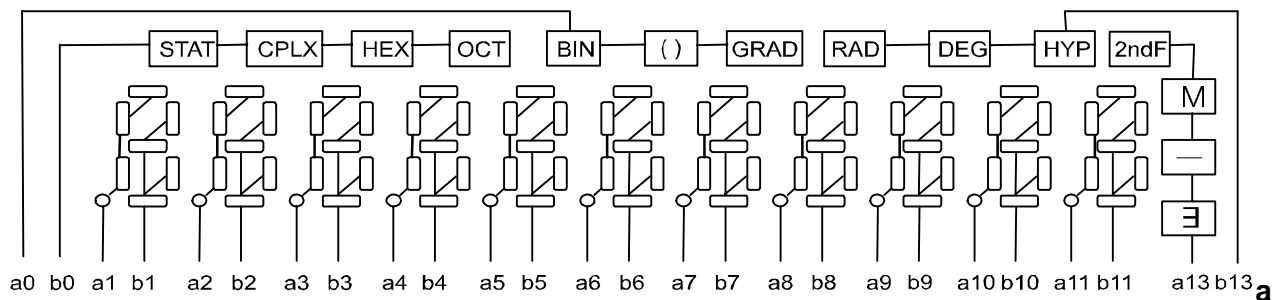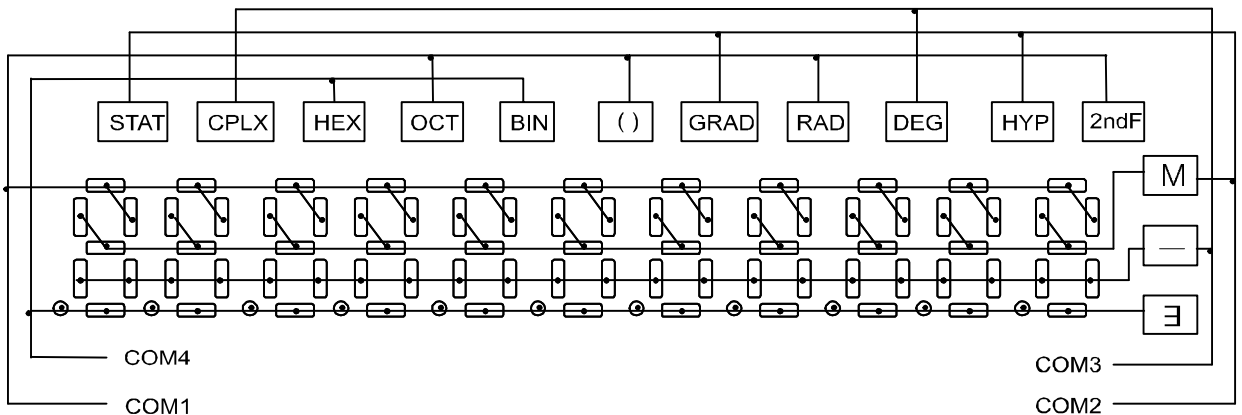
IZ1242M

WAVEFORM OF COMMON SIGNALS
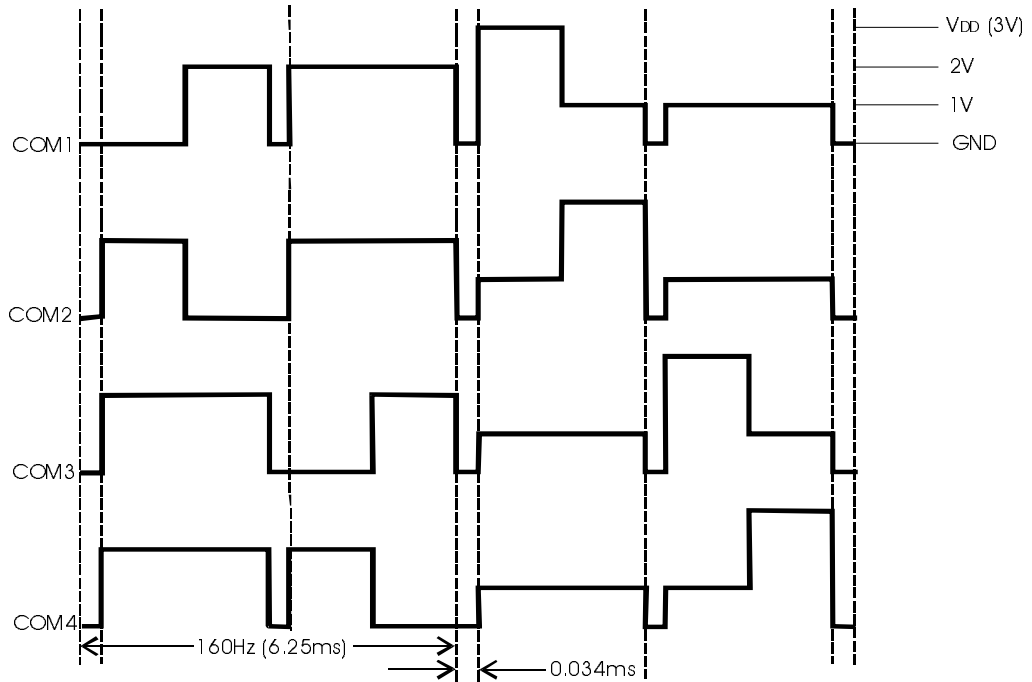
EXTERNAL CONNECTION
Pad description

Pad No.	Pad name	I/O	Description	Pad No.	Pad name	I/O	Description
	TST	I/O	Test	24	b7	O	LCD
	V_{DD}		V_{DD} Power (+ 3V)	25	a7	O	LCD
	Vss		Vss Power (GND)	26	V_{DD}		V_{DD} Power (+ 3V)
	KITEN	I	Key in test enable	27	Vss		Vss Power (GND)
	EXTNL	I	External clock	28	b6 (KO)	O	LCD (Key Output)
	FODIS	I	Fosc disable	29	a6 (KO)	O	LCD (Key Output)
	KI8	I	Key input 8	30	b5 (KO)	O	LCD (Key Output)
	T	I	Test	31	a5 (KO)	O	LCD (Key Output)
	KI4	I	Key input 4	32	b4 (KO)	O	LCD (Key Output)
	COM2	O	Common Signal 2	33	a4 (KO)	O	LCD (Key Output)
	COM3	O	Common Signal 3	34	b3 (KO)	O	LCD (Key Output)
	b13	O	LCD	35	a3 (KO)	O	LCD (Key Output)
	a13	O	LCD	36	b2 (KO)	O	LCD (Key Output)
	b12	O	No Connection	37	a2 (KO)	O	LCD (Key Output)
	a12	O	No Connection	38	b1 (KO)	O	LCD (Key Output)
	b11	O	LCD	39	a1 (KO)	O	LCD (Key Output)
	a11	O	LCD	40	b0 (KO)	O	LCD (Key Output)
	b10	O	LCD	41	a0 (KO)	O	LCD (Key Output)
	a10	O	LCD	42	COM4	O	Common Signal 4
	b9	O	LCD	43	COM1	O	Common Signal 1
	a9	O	LCD	44	KI2	I	Key input 2
	b8	O	LCD	45	KI1	I	Key input 1
	a8	O	LCD	46	DEN	I	Dump Enable

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INTEGRAL

IZ1242M

KEY CONNECTIONS

KI8 07

1st F	2nd F	HEX STAT
0		
=	%	
)	Σx	n
X→M	Σx²	x̄
RM	σ	S
M+	CD	DATA
—	→HEX	
3		
•	RND	
1		
4		
7		
+/-		
→DEG	→DMS	D

KI4 09

1st F	2nd F	HEX
2nd F		
+	→DEC	
(	X→Y	
÷	→BIN	
×	→OCT	
6		
9		
2		
5		
8		
yˣ	ˣ√y	B
EXP	π	A
hyp	archyp	

KI2 44

1st F	2nd F	HEX
OFF		
CE	n!	
→	CPLX	
F ↔ E	TAB	
b	→ xy	
x²	1/x	
a	→ rθ	
tan	tan⁻¹	
√	³√	C
cos	cos⁻¹	
log	10ˣ	F
ln	eˣ	E
sin	sin⁻¹	
DRG	DRG ►	

KI1 45

ON/C	STAT	

02 or 26

41 40 39 38 37 36 35 34 33 32 31 30 29 28
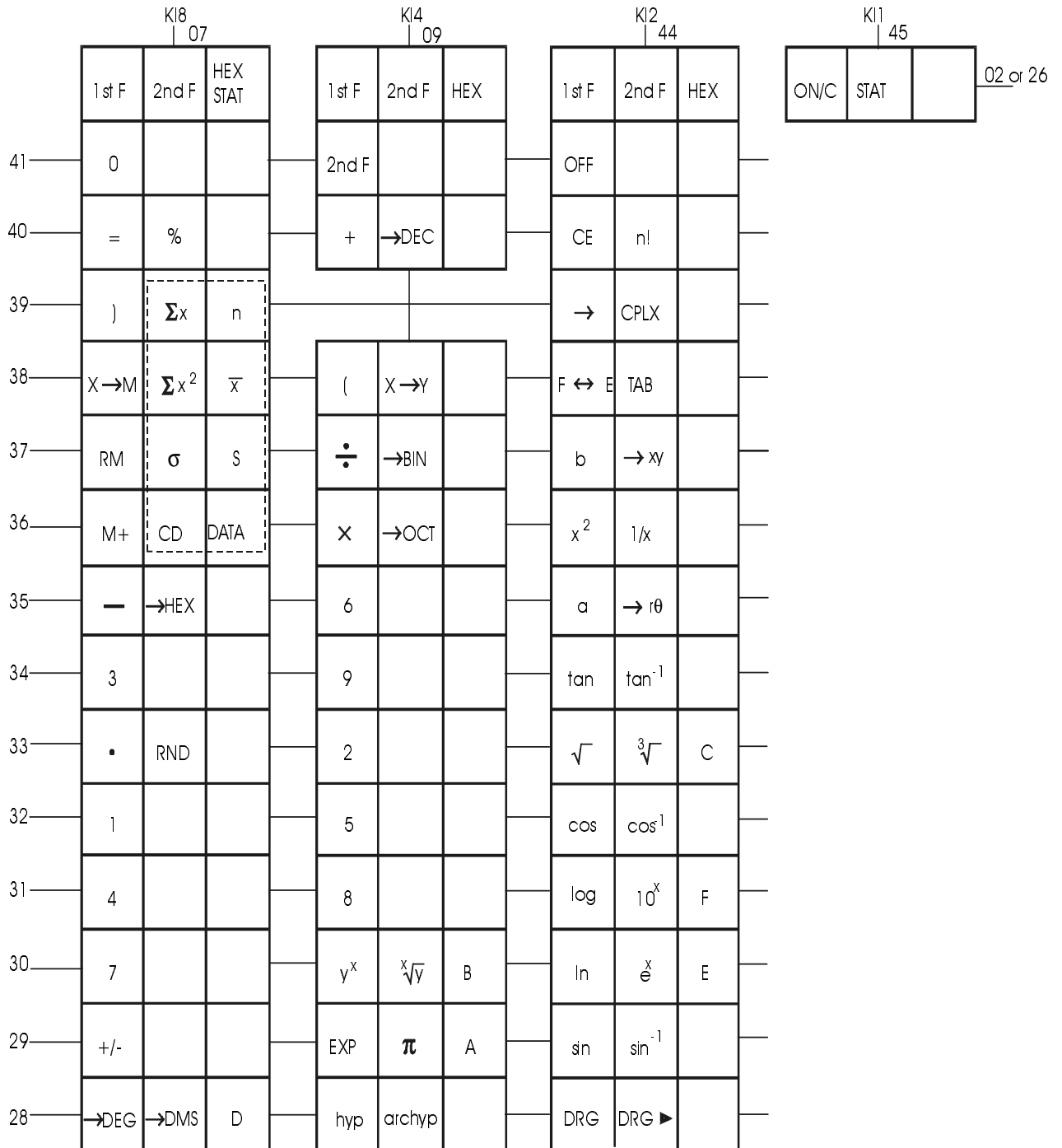
Note: ⌐ ⌐ = Statistic Mode Keys

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APPLICATION CIRCUIT
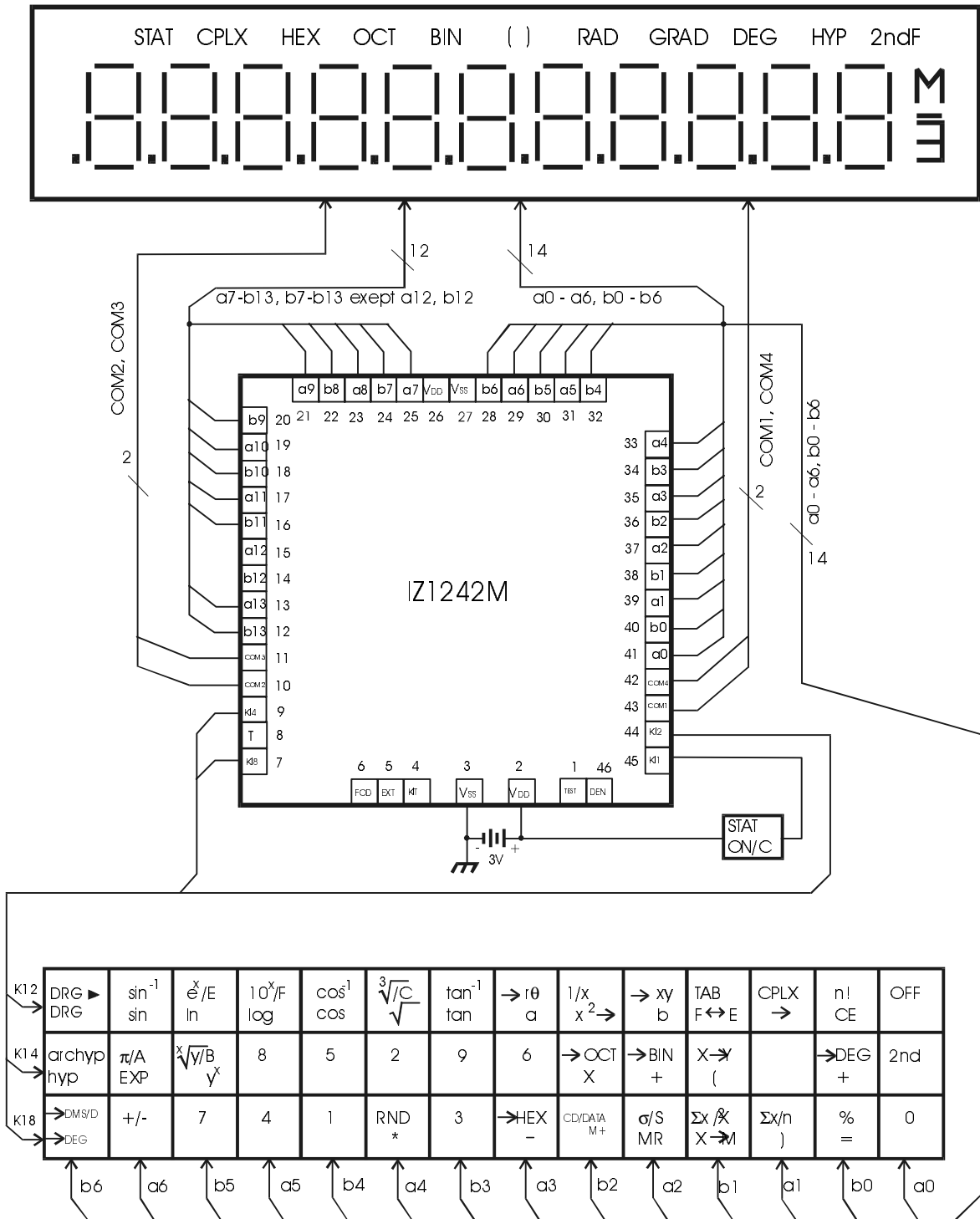
NOTE:

2nd F
1st F

2ndF/HEX
1st F

The chip substrate is electrically connected to V_{SS}

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PAD DIAGRAM

IZ1242M (CHIP)
Chip Size : 4080 x 4990
Pad Size : 100 x 100
Unit : μm

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