

IZ1242C

SCIENTIFIC 10 DIGITS LCD CALCULATOR

The IZ1242C 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 arctigonometric 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 (\bar{x})
 - total of all data (Σx)
 - 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 mode
DEG	Hyperbolic Degree	CPLX	Complex number mode
RAD	Radian	STAT	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
- Direct type

ABSOLUTE MAXIMUM RATINGS ($T_a = 25^\circ C$)

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	$^\circ C$
Storage Temperature	T_{stg}	- 55 ~ + 125	$^\circ C$

* Voltage greater than above may damage the circuit

IZ1242C

ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ\text{C}$, $V_{DD} = 3.0\text{V}$, $V_{SS} = 0\text{V}$ 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}	$V_{out} = 0\text{V}$	30	50	70	$\text{K}\Omega$
Key Pull Up Resistance (K18, K14, K12)	R_{pu}	$V_{out} = V_{DD}$	30	50	70	$\text{K}\Omega$
OSC Frequency	F_{dis}	Stand-by $V_{DD} = 3\text{V}$	30	45		KHz
	F_{opr}	Operating $V_{DD} = 3\text{V}$		200	280	
Frame Frequency	F_f	Stand-by $V_{DD} = 3\text{V}$	110	180		Hz
Supply Current	I_{OFF}	Display is off $V_{DD} = 3\text{V}$		1	3	μA
	I_{DIS}	Stand-by $V_{DD} = 3\text{V}$		20	35	
	I_{OPR}	Operation $V_{DD} = 3\text{V}$		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.

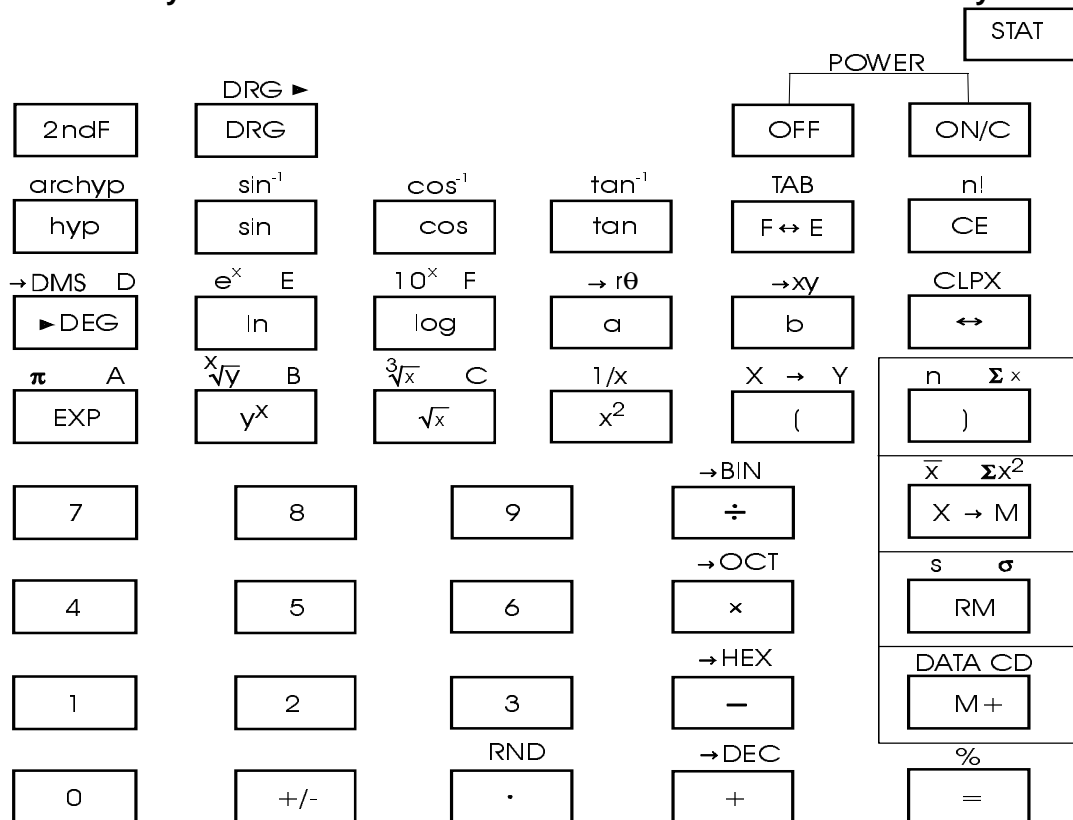
It is possible to specify the number of 0 to 9 digits below the decimal place by assignment of the decimal digit.

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

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



The condition during calculation

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

Display method

- Set number and result of operation are displayed in the right margin, minus floating.
- 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

$$\begin{aligned}
 10^{10} \leq |x| \leq 10^{100} & : \text{Exponent display} \\
 10^{-99} \leq |x| \leq 10^{-9} & : \text{Exponent display} \\
 0 \text{ and } 10^{-9} \leq |x| \leq 10^{10} & : \text{Floating display}
 \end{aligned}$$

- 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.

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.

IZ1242C

Example:

2	÷	7	=	0.285714285
---	---	---	---	-------------

TAB			
2ndF	F↔E	3	0.286

F↔E	2.857-01
-----	----------

TAB			
2ndF	F↔E	.	2.8571428-01

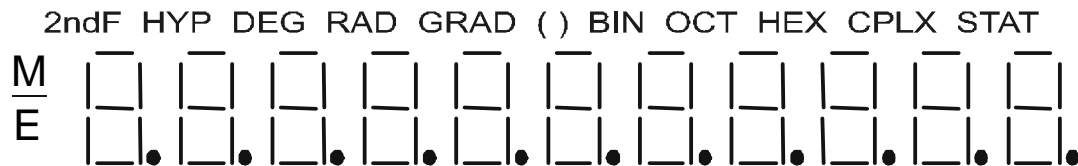
c. Negative numbers are not displayed with the minus symbol “-” but are displayed in hexadecimal, octal, and binary two’s complements.

d. Display style and special display

- Display style



- Special display



e. Examples of display

- Floating of -6000 1/x; TAB=7

-	□	□	□	□	1667
---	---	---	---	---	------

- Same as above, engineering display

-	□	□	□	□	□	□	□	-04
---	---	---	---	---	---	---	---	-----

- Error display

DEG	□
E	□

Protection

a. Memory overflow protection

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

IZ1242C

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.

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/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 →		0	x	x	x	x	0
	R → P							
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

IZ1242C

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

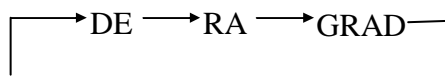
1. 2ndF

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.



b. Pressing this key after 2ndF key will change the mode of the angle and will convert the displayed data.

$$\begin{aligned} \text{DEG} &\rightarrow \text{RAD} && : \text{RAD} = \text{DEG} \times \pi/180 \\ \text{RAD} &\rightarrow && : \text{GRAD} = \text{RAD} \times 200/\pi \\ \text{GRAD} &&& \\ \text{GRAD} &\rightarrow \text{DEG} && : \text{DEG} = \text{GRAD} \times 0.9 \end{aligned}$$

3. 0 – 9

- 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.
- At the data input against the exponent, the last two numbers are efficient.

4. • RND

IZ1242C

- 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 \bullet 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 , $\sqrt[x]{y}$
 - 4) \times , \div
 - 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, +, -, \times , \div , y^x , $\sqrt[x]{y}$, =, (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 becomes 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 ($x \rightarrow M$, 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 $x \rightarrow M$ 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.

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 $a + b \quad \% = \rightarrow a + (a \times b)/100$ • $y^x, \sqrt[x]{y} \quad \% = \rightarrow a^t \quad (t = b/100)$
- Discount $a - b \quad \% = \rightarrow a - (a \times b)/100$ • $a \sqrt[x]{y} \quad \% = \rightarrow \sqrt[t]{a} \quad (t = b/100)$
- Percentag $a \times b \quad \% = \rightarrow (a \times b)/100$
- e $a \div b \quad \% = \rightarrow a/b \times 100$

**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 x² √ √³)
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.

1.999999999	-DMS	1	59	5999
		degree	minute	second

16. Coordinate conversion ($a \ b \rightarrow r \ \theta \rightarrow xy$).

- 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:

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

- 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

$(\rightarrow r, \theta) \ r = \sqrt{x^2 + y^2}, \ \theta = \tan^{-1} y/x$
 $(\rightarrow x, y) \ x = r \cos\theta, \ y = r \sin\theta$

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

IZ1242C

	Binary Number	Decimal Number
Outside the operation range	-	$512 \leq \text{DATA}$
Binary Positive Integer	1 1 1 1 1 1 1 1 1 1	511
	1 1 1 1 1 1 1 1 1 0	510
	1 1 1 1 1 1 1 1 0 1	509
	:	:
	:	:
	10	2
	1 0	1 0
Binary Positive Integer (Complement)	1 1 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 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		$-512 \geq \text{DATA}$

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	-	$5\ 3\ 6\ 8\ 7\ 0\ 9\ 1\ 2 \leq \text{DATA}$
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 7	-1
	7 7 7 7 7 7 7 7 7 6	-2
	1 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		$-5\ 3\ 6\ 8\ 7\ 0\ 9\ 1\ 3 \geq \text{DATA}$

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).

IZ1242C

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

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	$\frac{X1X2+Y1Y2}{X2^2+Y2^2}$	$\frac{Y1X2-X1Y2}{X2^2+Y2^2}$

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: $0 \leq | \text{data} | \leq 1 \times 10^{50}$. This data exceeds the ranges, it becomes an error.
- d. $n \quad \Sigma x \quad \Sigma x^2$
These keys display the number of data (sample), each sum total of x and sum total of x^2 .

• Average; $x = \frac{\sum_{i=1}^n x_i}{n} = \frac{\Sigma x}{n}$

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/n}{n-1}}$$

• The standard deviation of the sample

$$\delta = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}} = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/n}{n}}$$

• The standard deviation of the population

IZ1242C

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	$0 \leq x \leq 4.499999999 \times 10^{10}$	$0 \leq x \leq 5.729577951 \times 10^{-98}$	10 digits ± 1
	RAD	$0 \leq x \leq 7853981633$	—	
	GRAD	$0 \leq x \leq 4.999999999 \times 10^{10}$	$0 \leq x \leq 6.366197723 \times 10^{-98}$	
cos x	DEG	$0 \leq x \leq 4.500000008 \times 10^{10}$	—	
	RAD	$0 \leq x \leq 7853981649$	—	
	GRAD	$0 \leq x \leq 5.000000009 \times 10^{10}$	—	
tan x	DEG	$0 \leq x \leq 4.499999999 \times 10^{10}$	$0 \leq x \leq 5.729577951 \times 10^{-98}$	
	RAD	$0 \leq x \leq 7853981633$	—	
	GRAD	$0 \leq x \leq 4.999999999 \times 10^{10}$	$0 \leq x \leq 6.366197723 \times 10^{-98}$	
$\sin^{-1}x$	DEG	$0 \leq x \leq 1$	$0 \leq x \leq 1.570796326 \times 10^{-99}$	
	RAD	$0 \leq x \leq 1$	—	
	GRAD	$0 \leq x \leq 1$	$0 \leq x \leq 1.570796326 \times 10^{-99}$	
$\cos^{-1}x$	DEG	$0 \leq x \leq 1$	—	
	RAD	$0 \leq x \leq 1$	—	
	GRAD	$0 \leq x \leq 1$	—	
$\tan^{-1}x$	DEG	$0 \leq x \leq 9.999999999 \times 10^{99}$	$0 \leq x \leq 1.570796326 \times 10^{-99}$	
	RAD	$0 \leq x \leq 9.999999999 \times 10^{99}$	—	
	GRAD	$0 \leq x \leq 9.999999999 \times 10^{99}$	$0 \leq x \leq 1.570796326 \times 10^{-99}$	
ln x		$0 \leq x$	—	
log x		$0 \leq x$	—	
e^x		$-9.999999999 \times 10^{99} \leq x \leq 230.2585092$	$-9.999999999 \times 10^{99} \leq x \leq 227.9559243$	

IZ1242C

OPERATION RANGE AND ACCURACY (Continued)

Function	Operation Range	Under Flow Area	Normal Accuracy
10^x	$-9.999999999 \times 10^{99} \leq x \leq 99.999999999$	$-9.999999999 \times 10^{99} \leq x \leq 99.000000001$	10 digits ± 1
$x!$	$0 \leq x \leq 69$ (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	$0 \leq x \leq 9.999999999 \times 10^9$	$0 \leq x \leq 2.777777777 \times 10^{99}$	
$\sinh x$	$0 \leq x \leq 230.2585092$	—	
$\cosh x$	$0 \leq x \leq 230.2585092$	—	
$\tanh x$	$0 \leq x \leq 9.999999999 \times 10^{99}$	—	
$\sinh^{-1} x$	$0 \leq x \leq 4.999999999 \times 10^{99}$	—	
$\cosh^{-1} x$	$1 \leq x \leq 4.999999999 \times 10^{99}$	—	
$\tanh^{-1} x$	$0 \leq x \leq 9.999999999 \times 10^{-1}$	—	
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	$-9.999999999 \times 10^{99} \leq x, \ln y \leq 230.2585092$	$-9.999999999 \times 10^{99} \leq x, \ln y \leq -227.9559243$	
	$y > 0$; 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.		
$\sqrt[x]{y}$	$-9.999999999 \times 10^{99} \leq 1/x, \ln y \leq 230.2585092$	$-9.999999999 \times 10^{99} \leq 1/x, \ln y \leq -227.9559243$	
	$y > 0$; The above – mentioned operation range $y < 0$; x (odd) or $1/x$ (integer, x \neq 0) The above – mentioned operation range $y = 0$; x > 0.		
→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. $FDABF41C01 \leq x \leq FFFFFFFF, 0 \leq x \leq 2540BE3FF$		

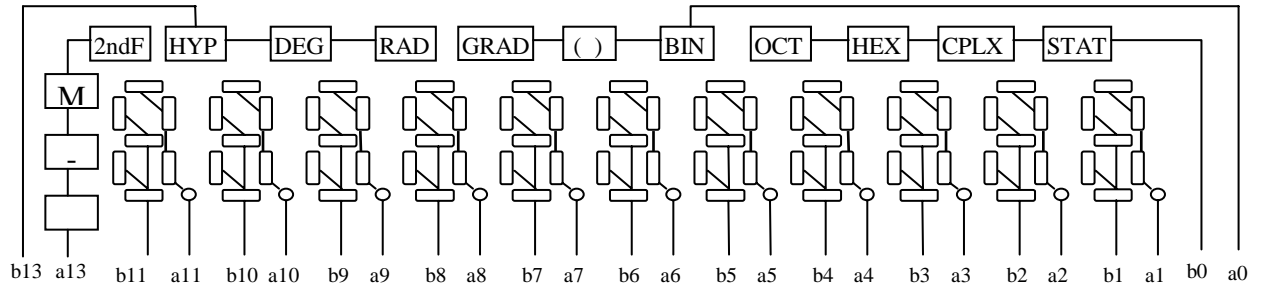
IZ1242C

OPERATION RANGE AND ACCURACY (Continued)

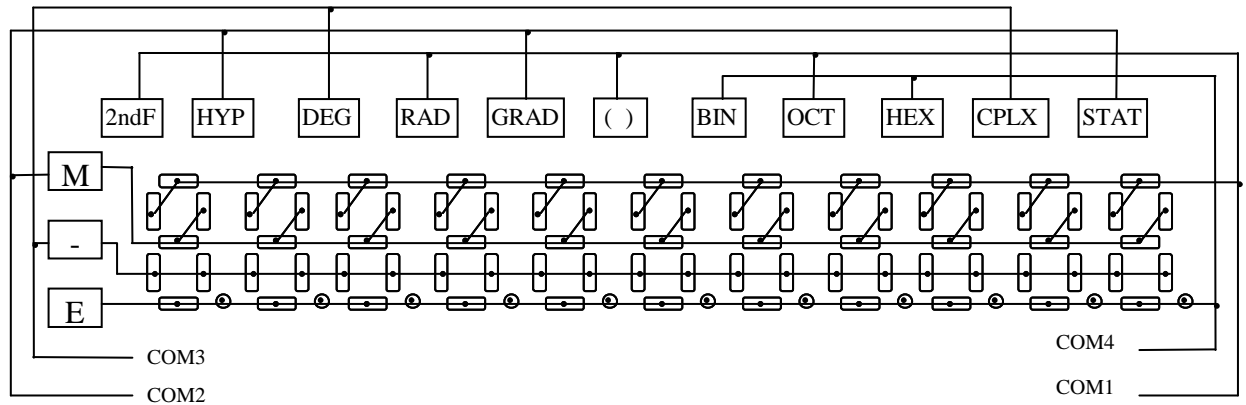
Function	Operation Range	Under Flow Area	Normal Accuracy
Complex number calculation	$(X1+Y1i) +, -, \times, \div (X2+Y2i)$ Addition and subtraction $ X1+X2 \leq 9.999999999 \times 10^{99}$ $ Y1+Y2 \leq 9.999999999 \times 10^{99}$ Multiplication $ X1X2-Y1Y2 \leq 9.999999999 \times 10^{99}$ $ Y1X2+X1Y2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

LCD CONNECTION

a. Segment

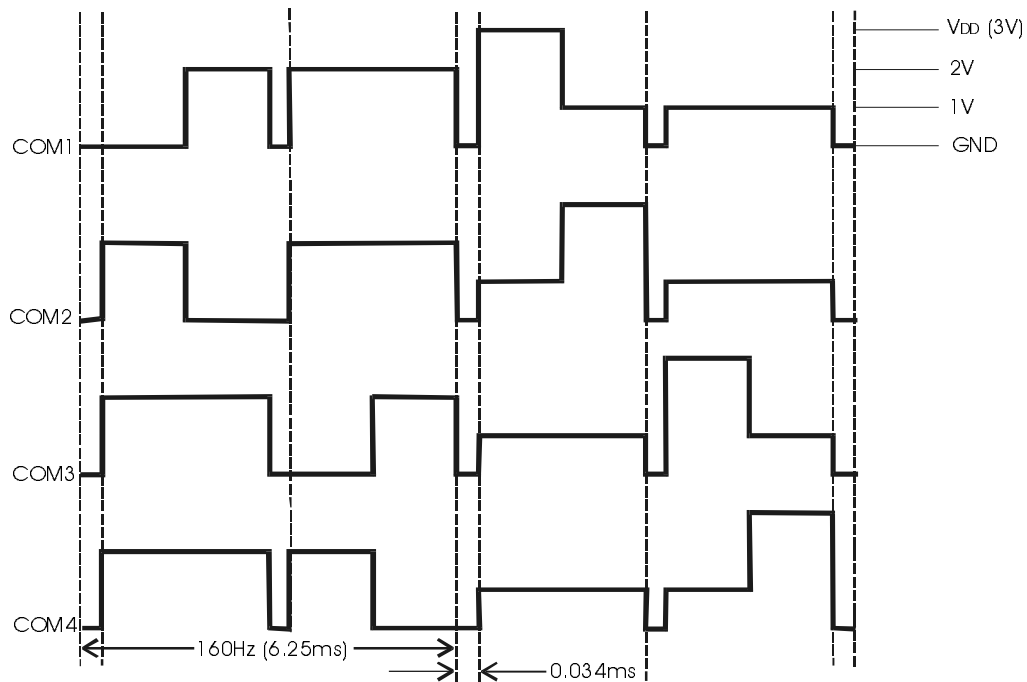


b. Common



IZ1242C

WAVEFORM OF COMMON SIGNALS



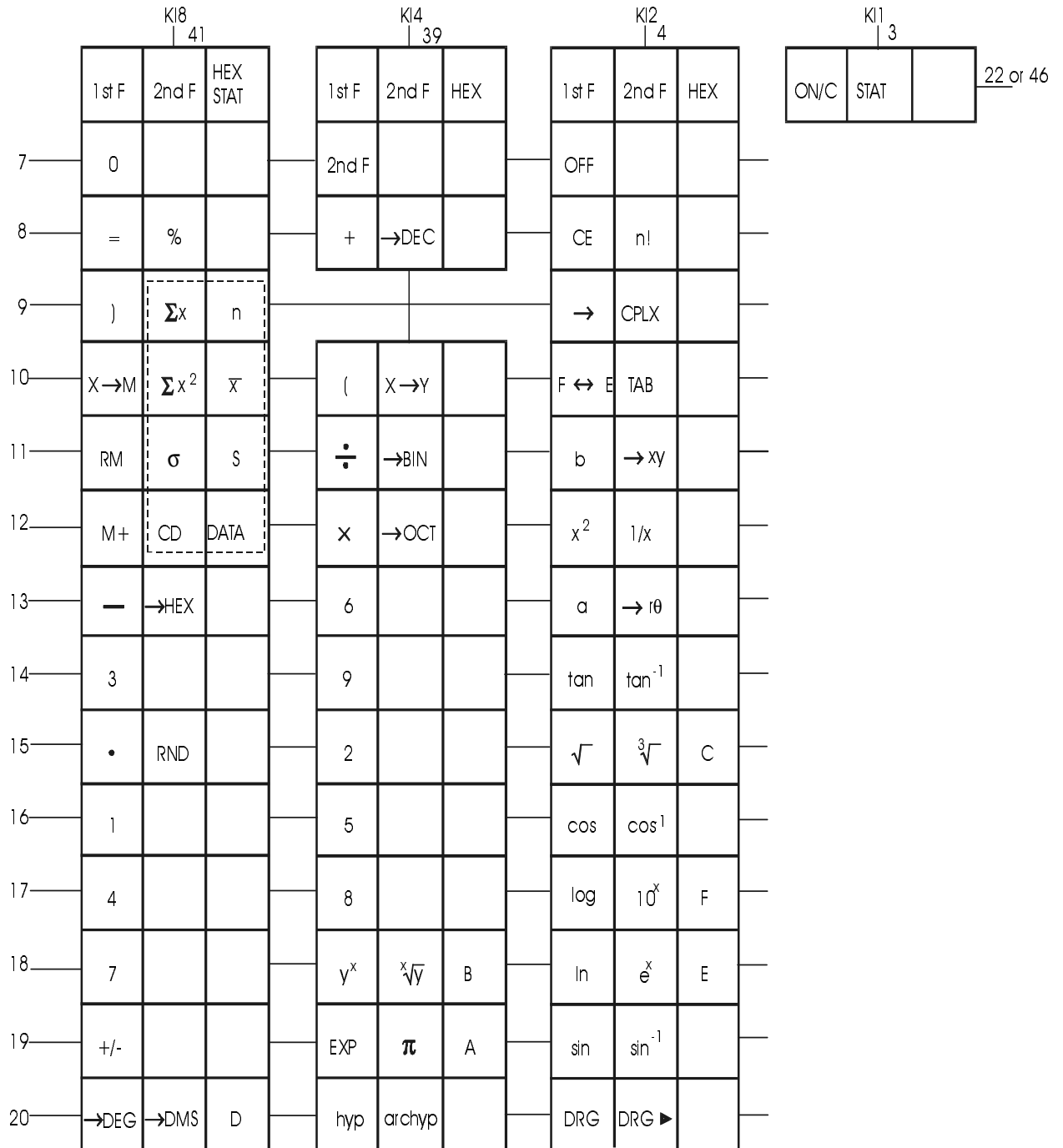
EXTERNAL CONNECTION

Pad description

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

IZ1242C

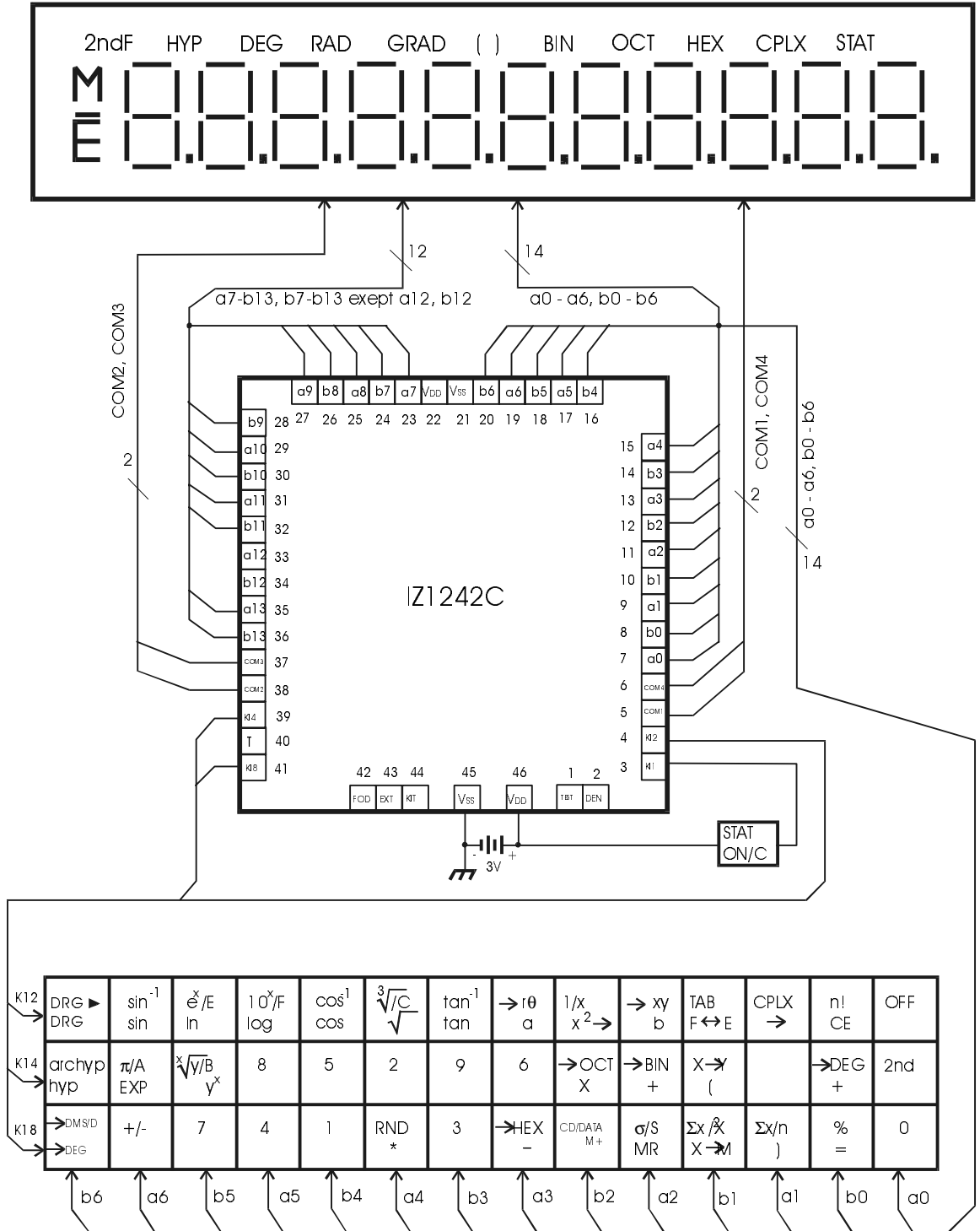
KEY CONNECTIONS



Note: = Statistic Mode Keys

IZ1242C

APPLICATION CIRCUIT



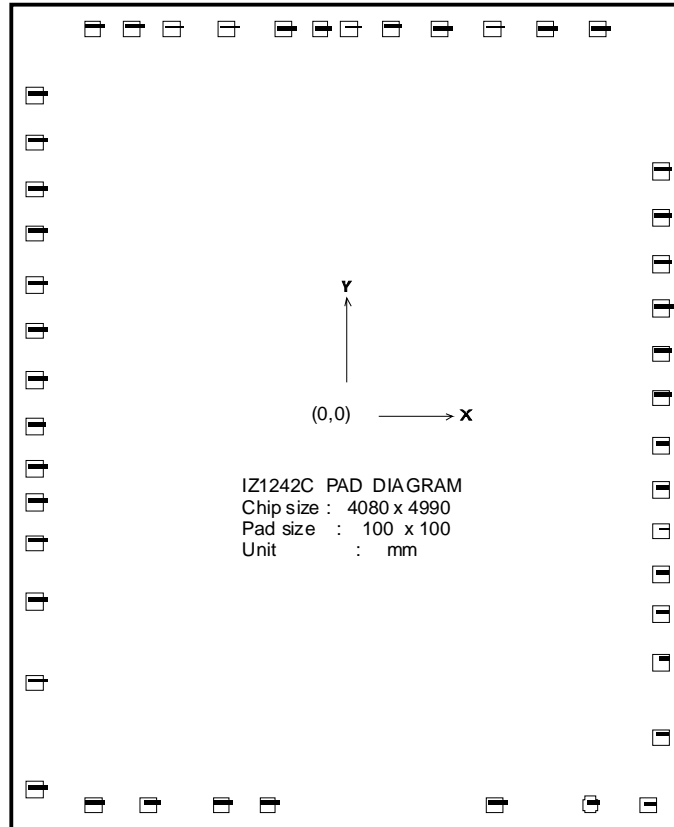
NOTE:

2nd F	2ndF/HEX
1st F	1st F

The chip substrate is electrically connected to V_{SS}

IZ1242C

PAD DIAGRAM



PAD LOCATION

Pad No.	Pad Name	Description	X	Y	Pad No.	Pad Name	Description	X	Y
1	TEST	Test	2793	104	24	b7	LCD	1053	3851
2	DEN	Dump enable	3074	104	25	a8	LCD	769	3851
3	KI1	Key Input 1	3154	441	26	b8	LCD	562	3851
4	KI2	Key Input 2	3154	799	27	a9	LCD	356	3851
5	COM1	Common Signal 1	3154	1081	28	b9	LCD	104	3548
6	COM4	Common Signal 4	3154	1297	29	a10	LCD	104	3324
7	a0	LCD	3154	1533	30	b10	LCD	104	3100
8	b0	LCD	3154	1760	31	a11	LCD	104	2869
9	a1	LCD	3154	2002	32	b11	LCD	104	2636
10	b1	LCD	3154	2245	33	a12	No Connection	104	2411
11	a2	LCD	3154	2487	34	b12	No Connection	104	2171
12	b2	LCD	3154	2729	35	a13	LCD	104	1948
13	a3	LCD	3154	2971	36	b13	LCD	104	1742
14	b3	LCD	3154	3213	37	COM3	Common Signal 3	104	1558
15	a4	LCD	3154	3455	38	COM2	Common Signal 2	104	1349
16	b4	LCD	2824	3851	39	KI4	Key Input 4	104	1081
17	a5	LCD	2582	3851	40	T	Test	104	703
18	b5	LCD	2340	3851	41	KI8	Key Input 8	104	185
19	a6	LCD	2098	3851	42	FOD	FOSC disable	358	104
20	b6	LCD	1856	3851	43	EXT	External Clock	660	104
21	V _{SS}	GND	1650	3851	44	KIT	Key in Test enable	1008	104
22	V _{DD}	+3.0V Power	1490	3851	45	V _{SS}	GND	1233	104
23	a7	LCD	1295	3851	46	V _{DD}	+3.0V Power	2329	104