

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**J T C 8 3 2 3 0 - 0 0 1 7 S****JTC83230-0017S : SINGLE-CHIP CMOS LSI FOR CALCULATORS WITH  
PRINTERS (APPLICABLE PRINTER HEADS : M31 / M31A  
MANUFACTURED BY EPSON)**

The JTC83230-0017S LSI is a single-chip CMOS LSI for use in calculators with printers. It integrates I/O logic circuits necessary to configure a calculator with 10- or 12-digit display, two-memory function, two-tax function, serial printer used to print calculation results, oscillator, and LCD drivers.

**FEATURES****Operational Features**

- Print 10 or 12 digits of data. (including decimal point.) 1 digit of minus sign, 2 digits of operational symbol.  
1-color printing (black).
- Display 10 or 12 digits of data. (including punctuation in each digit.) 1 digit of floating minus sign, memory load, error symbol, grand total memory load, 3 digits of commas.
- Decimal output Decimal set lock key controls output format. Fixed decimal setting ("0", "1", "2", "3", "4", "6"), full floating decimal, ADD mode and ADD2 mode.
- Key-input buffer 12 words
- Operation methods addition and subtraction : by ARITHMETIC operation  
multiplication and division : by algebraic operation
- Function four function, repeat multiplication and division, mixed calculation, percentage calculation, percent discount and add-on calculation, memory calculation, delta percent calculation, add-mode calculation, mark-up / down calculation, total calculation, constant calculation, tax calculation  
Two-key rollover

- Leading zero suppression

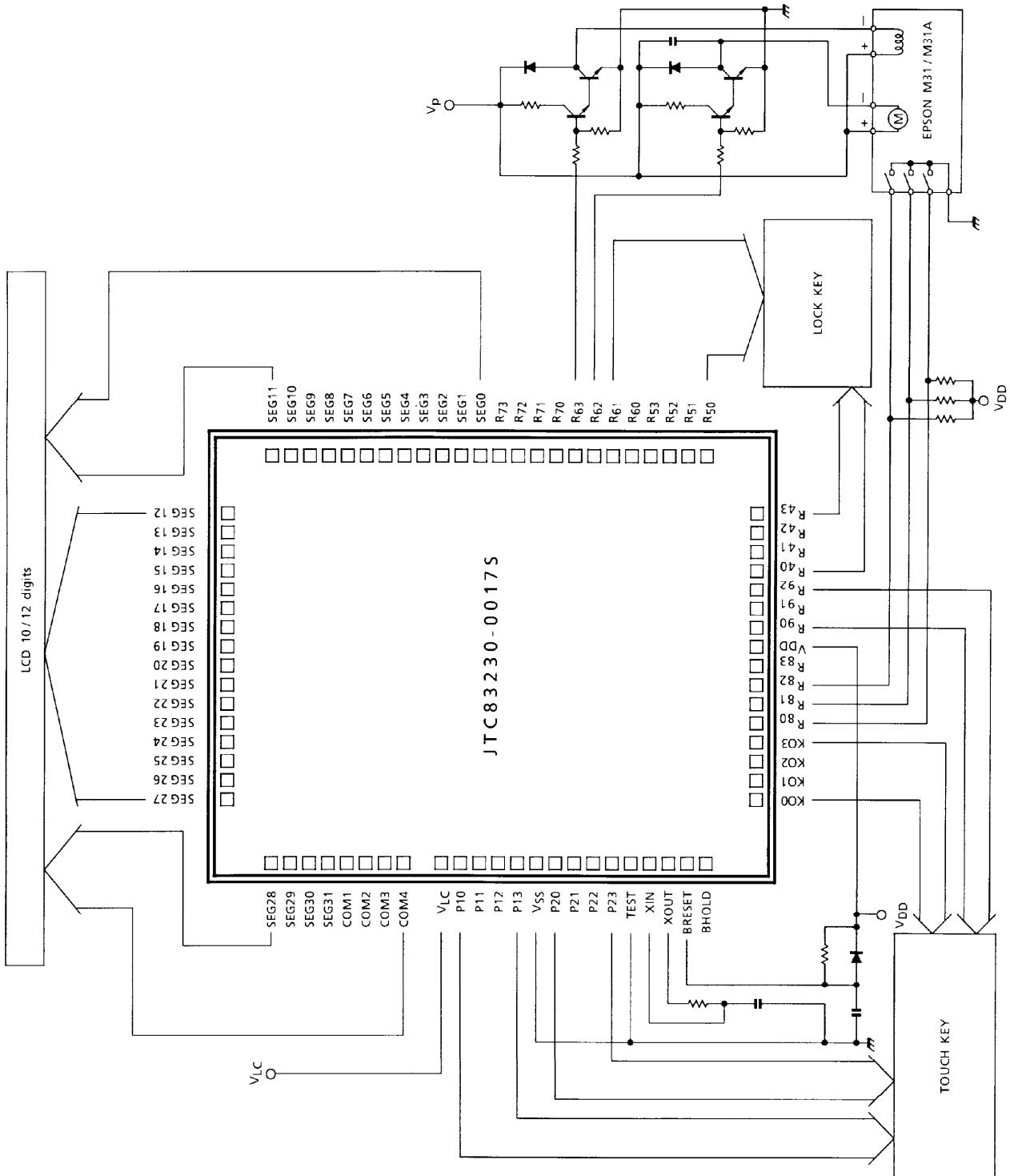
**Protection**

- i) In the overflow condition, all key except "C", "C/CE", "CE", "Feed", "→" key are inoperative.
- ii) Key chatter protection.

**Auto-clear at power on**

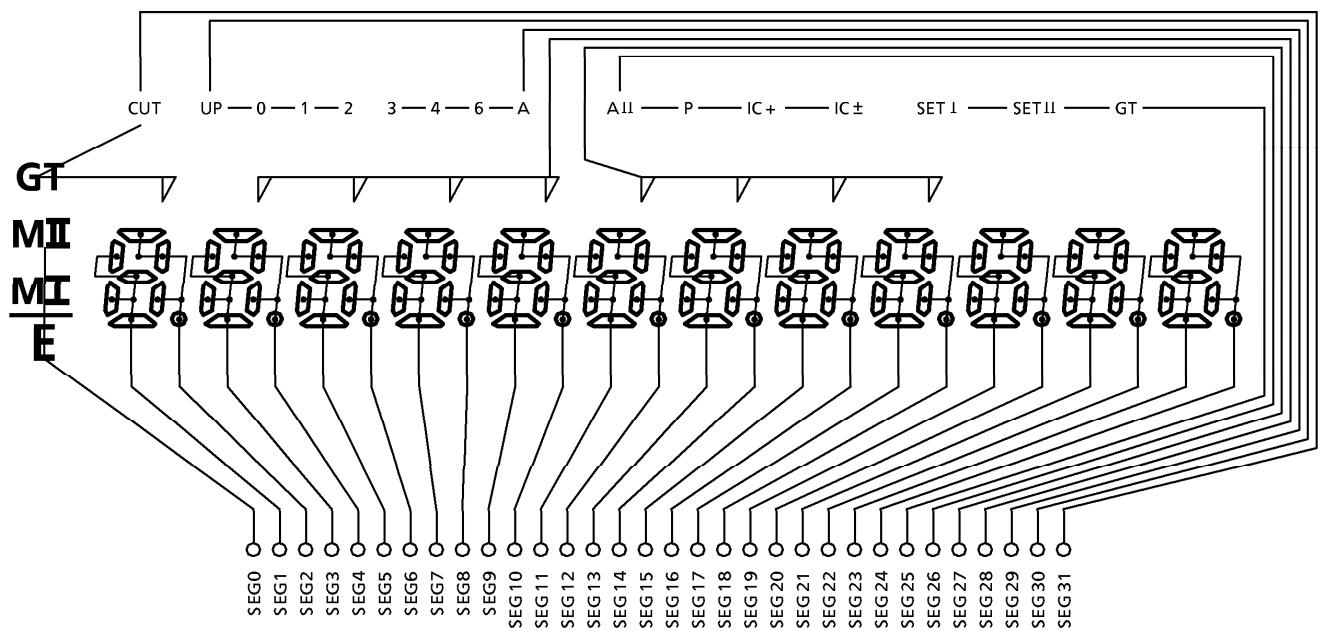
Auto-clear functions by connecting a capacitor to the RESET pin.

## SYSTEM BLOCK DIAGRAM

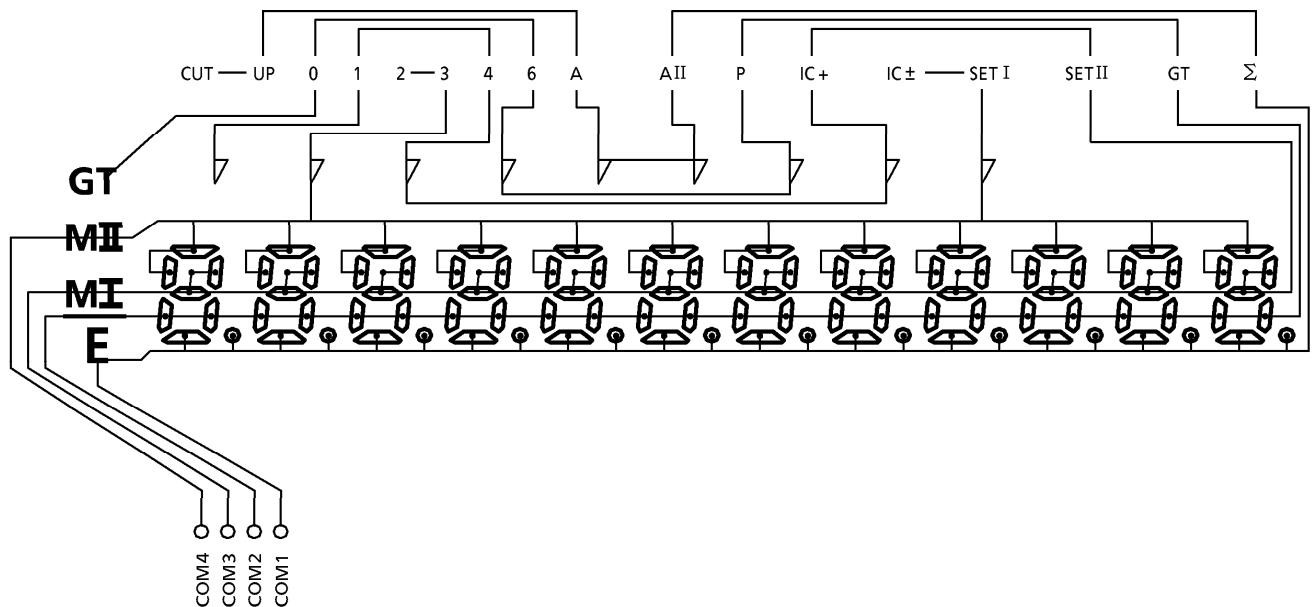


## CONNECTION OF LCD

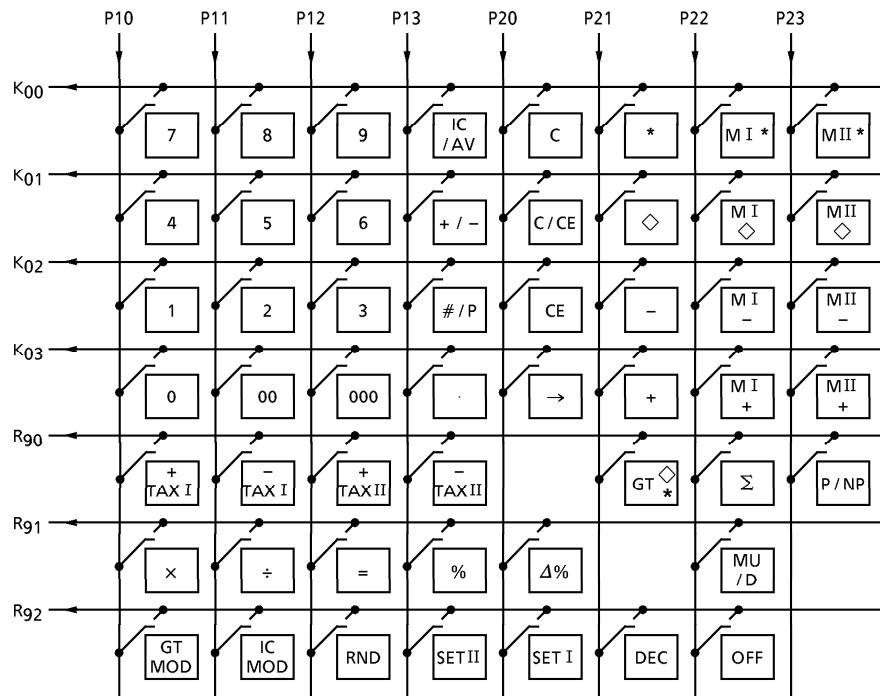
## SEGMENT



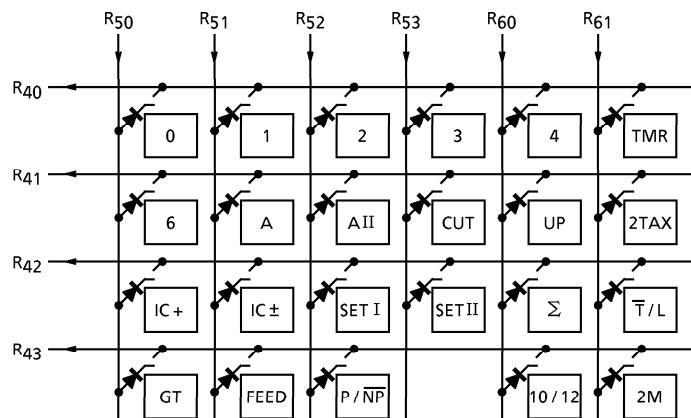
## COMMON



## KEY CONNECTION

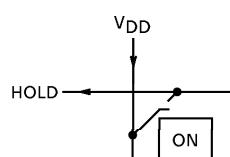


Touch Key



Lock Key

Touch Key select



ON Key

## SPECIFICATION OF CALCULATOR

## Operation specifications

## 1) Operations depending on key types and modes

- Touch key

KEY NAME	CAL MODE		TAX SET MODE (SET I / II KEY IS ON)	
MODE SWITCH	TOUCH KEY MODE	LOCK KEY MODE	TOUCH KEY MODE	LOCK KEY MODE
C	Operates as clear key	Operates as clear key	Clears input data	Clears input data
CE	Operates as clear entry key	Operates as clear entry key	Clears input data	Clears input data
C / CE	Operates as clear or clear entry key	Operates as clear or clear entry key	Clears input data	Clears input data
Numeral	Numeral Key- inputs numerals	Numeral Key- inputs numerals	Inputs numerals	Inputs numerals
OFF	Operates as off key	—	Unused	Unused
.	Key-inputs decimal points	Key-inputs decimal points	Key-inputs decimal points	Key-inputs decimal points
*, ◇	Operates as total or sub-total key	Operates as total or sub-total key	Unused	Unused
+, - ×, ÷	Operates as four-function key	Operates as four-function key	Unused	Unused
=	Operates as = key	Operates as = key	Unused	Unused
P / NP	Switches print or non-print	—	Unused	Unused
RND	Switches round-off and round-up	—	Unused	Unused
DEC	Switches decimal points	—	Unused	Unused
%	Operates as % key	Operates as % key	Unused	Unused
Δ%	Operates as delta percentage calculation key	Operates as delta percentage calculation key	Unused	Unused
MU / D	Operates as mark-up / down key	Operates as mark-up / down key	Unused	Unused
IC / AVE	Operates as item count key or average key	Operates as item count key or average key	Unused	Unused
# / P	Operates as non-add-print key for left-justified printing	Operates as non-add-print key for left-justified printing	Unused	Unused
→	Operates as right-shift key	Operates as right-shift key	Operates as right-shift key	Operates as right-shift key
+ / -	Operates as sign change key	Operates as sign change key	Unused	Unused

Oscillates only low clock frequency. (connected XTIN, XTOUT)

KEY NAME	CAL MODE		TAX SET MODE (SET I / II KEY IS ON)	
MODE SWITCH	TOUCH KEY MODE	LOCK KEY MODE	TOUCH KEY MODE	LOCK KEY MODE
MI *, MII *	Operates as memory function key	Operates as memory function key	Unused	Unused
MI $\diamond$ , MII $\diamond$ ,				
MI -, MII -,				
MI +, MII +				
- TAX I / II	Operates as - TAX I / II key	Operates as - TAX I / II key	Unused	Unused
+ TAX I / II	Operates as + TAX I / II key	Operates as + TAX I / II key	Unused	Unused
$\Sigma$	Operates as $\Sigma$ key	—	Unused	Unused
IC MOD	Operates as IC-mode key	—	Unused	Unused
GT MOD	Operates as GT-mode or non-GT mode key	—	Unused	Unused
GT $\diamond$ *	Operates as GT key	Operates as GT key	Unused	Unused
EXC	Operates as EXC key	Operates as EXC key	Unused	Unused
$\sqrt{ }$	Operates as $\sqrt{ }$ key	Operates as $\sqrt{ }$ key	Unused	Unused

- Lock key

KEY NAME	CAL MODE		TAX SET MODE (SET I / II KEY IS ON)	
MODE SWITCH	TOUCH KEY MODE	LOCK KEY MODE	TOUCH KEY MODE	LOCK KEY MODE
0, 1, 2, 3, 4, 6, A, AII	—	Switches decimal points	Unused	Unused
CUT, UP	—	Switches round-off and round-up	Unused	Unused
IC $\pm$ , IC +	—	Operates as IC $\pm$ / IC + key	Unused	Unused
$\Sigma$	—	Operates as $\Sigma$ key	Unused	Unused
GT	—	Switches GT-mode or non-GT mode	Unused	Unused
FEED	Operates as paper feed key	Operates as paper feed key	Operates as paper feed key	Operates as paper feed key
P / $\overline{NP}$	—	Switches print or non-print	Unused	Unused
* $\overline{T/L}$	Selects lock key mode or touch key mode.			
* 2TAX	Selects single tax mode or double tax mode.			
* 2M	Selects single memory mode or double memory mode.			

\* Can switch modes only with the reset key.

## 2) Explanation of function

[0~9] ..... Keys in numbers from 0 to 9, 00, and 000. If the number of displays digits exceeds 10 or 12 key entry is invalid.

[.] ..... If this key is pressed after a key operation except data entry, the displays is cleared and entry of [.] is stored in memory. The decimal point is shifted for subsequent data entry. If the [.] key is pressed during data entry, displays does not change.

[+, -] ..... Add or subtract operation data and displays the result. The decimal point is floating except when A mode is specified. Addition or subtraction can be performed repeatedly.  
If these key are pressed in multiplication/division mode or in constant calculation mode, add or subtract displays data to addition/subtraction registers, then displays the result. At this time, in the operation mode multiplicand or divisor do not change.  
These keys increment or decrement the item counter. In the following operation mode, the operations are executed, and the results are printed and displayed. At that time, addition or subtraction using the addition/subtraction register is not executed.

(1) percent discount/add-on calculation

$$a \times b\% + \dots \dots a + (ab / 100)$$

$$c\% + \dots \dots a + (ac / 100)$$

$$a \times b\% - \dots \dots a - (ab / 100)$$

$$c\% - \dots \dots a - (ac / 100)$$

Percent discount/add-on with constants are calculated as above.

[◊] ..... Prints and displays the intermediate result in addition/subtraction register. In item count mode, prints the contents of the item counter before the calculation result printing.  
Contents of data register or stored arithmetic instruction are not changed.

[\*] ..... Prints and displays the result in addition/subtraction register. Automatically feeds paper one line. In item count mode, the contents of the item counter are printed before the calculation result printing.  
After this key operation, the contents of the addition/subtraction register are cleared. The contents of the item counter are cleared at the first addition/subtraction in next step. The contents of the data register or stored arithmetic instruction are not changed. When GT mode is specified, the result of addition/subtraction is added to the GT memory.

**[M I +, MII +]** ... If the arithmetic instruction is not stored or if the mode is constant calculation mode, first prints the displays contents after rounding to the specified number of decimal places, performs addition / subtraction using the data in memory, then stores the result in memory. If the multiplication / division instruction is stored, executes the arithmetic instruction, rounds the result to the specified number of decimal places, prints and displays the result, adds / subtracts with the data in memory, then stores the result to memory.  
 At that time, the multiplicand or divisor is stored together with the mode, constant calculation mode. When this key is pressed immediately after the [x] or [M I +, MII +, M I -, MII -] key, operation is the same as that for the [=] key ; that is, adds / subtracts using data in memory. This key operation increments or decrements the item counter for memory.

**[M I ◇, MII ◇]** ... Prints or displays the intermediate result of memory calculation. In item count mode, prints the contents of the item counter for memory before the calculation result printing. Contents of the data register or stored arithmetic instruction are not changed.

**[M I \*, MII \*]** .... Prints and displays the result of memory calculation and automatically feeds paper one line. In item count mode, prints the contents of the item counter for memory before the calculation result printing. After the [M I \*, MII \*] key operation, the contents of memory and the contents of the item counter for memory are cleared. Contents of the data register or stored arithmetic instruction are not changed.

**[x, ÷]** ..... If the multiplication or division instruction is stored in memory, prints the operators, performs the operations and displays the results while simultaneously storing a new arithmetic instruction in memory. The decimal point for the result is floating. If the [x] or [÷] key is pressed in constant calculation mode, prints the displayed numeric value without performing an operation and stores a new multiplication / division instruction in memory.

**[=]** ..... Executes a stored multiplication / division instruction, rounds the result to the specified number of decimal places, prints and displays the result, then automatically feeds the paper one line. Stores the multiplicand or divisor together with constant calculation mode in memory. If an instruction is not stored in memory, no operation is performed and the previous state is held. Pressing the [=] key immediately after the [x] or [÷] key performs the following operation.

$a \times = \dots \dots aa$

$a \div = \dots \dots 1$

[%] ..... If an arithmetic instruction is stored in memory, performs percentage calculation, rounds the result to the specified number of decimal places, prints and displays the result. Stores the multiplicand / divisor together with constant calculation mode in memory. If a percentage calculation for multiplication is performed, percent discount/add-on calculation can be done by using the [+] or [-] key. At that time, addition / subtraction using the addition / subtraction register is not performed. If an arithmetic instruction is not stored in memory, no operation is performed and the previous state is held. Pressing the [%] key immediately after the [x] or [÷] key performs the following operation.

$$a \times \% = \dots \dots aa / 100$$

$$a \div \% = \dots \dots 100$$

% key operation example : percent discount / add-on calculation

$$a \times b \% = \dots \dots ab / 100$$

$$+ \dots \dots a + (ab / 100)$$

$$c \% = \dots \dots ac / 100$$

$$+ \dots \dots a + (ac / 100)$$

$$a \times b \% = \dots \dots ab / 100$$

$$- \dots \dots a - (ab / 100)$$

$$c \% = \dots \dots ac / 100$$

$$- \dots \dots a - (ac / 100)$$

[MU / D] ..... If a multiplication/division instruction is stored in memory, cancels the data. The decimal point for the result is floating.

MU / D key operation example :

$$aMU / Db = \dots \dots a / (1 - (b / 100)) - a \quad (\text{Prints profit})$$

$$a / (1 - (b / 100)) \quad (\text{Mark-up})$$

$$c = \dots \dots a / (1 - (c / 100)) - a \quad (\text{Prints profit})$$

$$a / (1 - (c / 100)) \quad (\text{Mark-up})$$

$$aMU / Db + / - = \dots \dots a / (1 + (b / 100)) - a \quad (\text{Prints profit})$$

$$a / (1 + (b / 100)) \quad (\text{Mark-down})$$

$$c + / - = \dots \dots a / (1 + (c / 100)) - a \quad (\text{Prints profit})$$

$$a / (1 + (c / 100)) \quad (\text{Mark-down})$$

[Δ%] ..... If a multiplication/division instruction is memorized, cancels the data.

Δ%key operation example :

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aΔ% b = ..... b - a
          (b - a) / |a| (Prints difference)
c = ..... c - a      (Change delta percent)
          (c - a) / |a| (Prints difference)
aΔ% b + / - = ..... - (b + a) (Change delta percent)
          - (b + a) / |a| (Prints difference)
c + / - = ..... - (c + a) (Change delta percent)
          - (c + a) / |a| (Prints difference)

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[+/-] ..... Inverts sign of the displayed number at key entry.

[→] ..... Shifts the contents of the displays to the right by one digit at key entry. For an estimation calculation error, cancels the error.

[GT\* $\diamond$ ] ..... Calls the contents of GT memory. If the key is pressed once, calls the contents of GT memory, but does not change current state. If the key is pressed twice, calls the contents of GT memory and clears them.

[C] ..... Cancels all arithmetic instructions and errors, clears the contents of all the registers except the memory register, and prints 0.C.

[CE] ..... If pressed at key entry, clears only the contents of the displays ; does not change the stored arithmetic instruction or the contents of the data register. Invalid if pressed after one of the following keys : [C][×][÷][+][−][=][%][Δ%][M I +, MII +][M I −, MII −][M I  $\diamond$ , MII  $\diamond$ ][M I \*, MII \*][MU/D][IC/AVE].

The result of pressing the [CE] key after the [#/P] key depends on the state before the keys were pressed.

[IC+] ..... Selects item count mode.

[IC $\pm$ ] ..... IC+ ..... Counts up by the [+] or [−] key.

IC $\pm$  ..... Counts up by the [+] key, down by the [−] key.

[Σ] ..... If an operation is performed by the [=] or [%] key in auto accumulation calculation mode, adds the operation result to the addition/subtraction register and increments the item counter.

[C/CE] ..... If pressed at key entry, operates same as the [CE] key.  
 If pressed after one of the following keys, operates same as the [C] key : [C / CE] [×] [÷] [+] [−] [=] [%] [Δ%] [M I +, MII +] [M I −, MII −] [M I ◇, MII ◇] [M I \*, MII \*] [MU / D] [IC / AVE].  
 The result of pressing the [C/CE] key after the [+ / -] or the [# / P] key depends on the state before the keys were pressed.

[# / P] ..... If pressed after the numerical key entry, prints the contents of the key entry data register together with the # symbol, but does not change the current state. If the key is pressed after a key except the numerical keys or [+ / -] key, does not change the contents of the displays or the current state. If the key is pressed in clock mode, automatically prints the displayed date and time.

$$\begin{bmatrix} +\text{TAX I / II} \\ -\text{TAX I / II} \end{bmatrix}$$
 .. Calculate included tax operation or excluded tax operation. But, only prints and does not express the tax. Prints or displays the result-value. (Result-value adjusts decimal-point (TAB) setting.) Feeds the paper one line after prints.  
 TAX I key operation example : (TAX = 3%)  
 a [+TAX I] .. a (3 / 100) (Prints TAX)  
 ... a + (a (3 / 100)) (Included TAX)  
 a [-TAXII] .. a / (1 + 3 / 100) − a (Prints TAX)  
 ... a / (1 + 3 / 100) (excluded TAX)

If pressed at key entry after number key entry, calculate the tax as a result of calculation.  
 When multiplication / division instruction is stored in memory.

[P / NP] ..... Switches between PRINT and NON-PRINT mode. At reset, NON-PRINT mode is set. Switches mode in each time when the [P / NP] key is pressed : P→NP→P→NP. In PRINT mode, displays "print mode". Valid only when the [T / L] lock key is off.

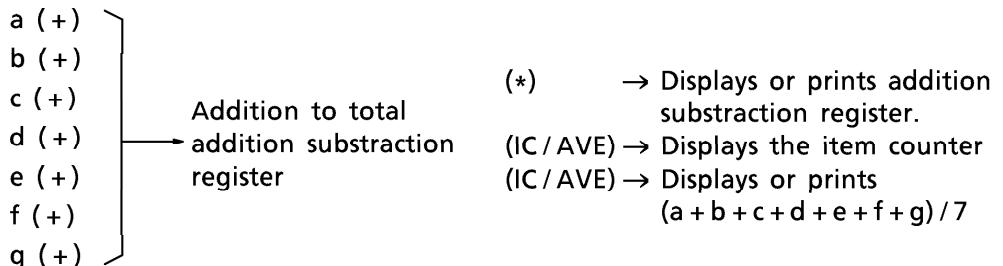
[RND] ..... Switches between round-up, round-off and half-adjust. At reset, half-adjust is set. Switches the mode in each time when the [RND] key is pressed : 5 / 4 → ↓ → ↑ → 5 / 4 → ↓ → ↑. Displays round-up / round-off. Valid only when the [T / L] lock key is off.

[GT MOD] ..... Exchange GT-mode. (Initial setting isn't support GT-mode.)  
 GT mode cycles not-support and support. And displays GT-mode flag.  
 Only touch key mode is valid.

[IC MOD] ..... Exchange IC-mode. (Initial setting isn't support IC-mode.)  
 IC mode cycles not-support, IC+ and IC±-mode. And displays IC-mode flag.  
 Any touch key mode is valid.

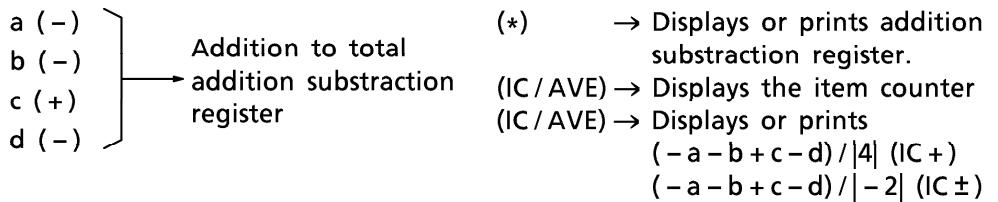
[IC/AVE] ..... Prints or displays the item counter, when IC/AVE key continuously pressed twice just after pressed [\*] key and [◇] key,  
 After first, prints or displays the item counter.  
 The second, the calculation of the mean number are executed, prints or displays the operation result.  
 After calculation of the mean number, item counter are cleared.

## Example



Then even if IC-value is a negative, the calculation of the mean number.

## Example



[DEC] ..... Switches the decimal point. At reset, floating point (F) is set. Switches the mode in each time when the [DEC] key is pressed as follows : F→0→1→2→3→4→6→A→A II→F→0→1. Displays the specified decimal point or add mode. Valid only when the [T/L] lock key is off.

### 3) Explanation of lock keys

[0, 1, 2, 3] .... Sets the specified decimal point. If no specification, floating is set.

[4, 6, A, AII] When processing floating point data, the operation result is zero-shifted. When A mode is specified, key-entered data are multiplied by 1/100 only when the key-entered numerical value is used for addition/subtraction or memory addition/subtraction. If the [·] key is pressed during data entry, A mode is invalid. The operation result is treated the same as the specified decimal point, 2. When AII mode is specified, key-entered data are multiplied by 1/100 only when the key-entered numerical value is used for multiplication/division by [=] key. If the [·] key is pressed during data entry, AII mode is invalid. The operation result is treated the same as the specified decimal point, 2.

[CUT, UP] ..... Rounds-off in CUT mode ; rounds-up in UP mode ; when no specification is made, half-adjusts. When a decimal point is specified, the digit(s) in the subsequent decimal place is (are) half-adjusted, rounded-off, or rounded-up (??). If floating point is specified, the value of the least significant digits which cannot be displayed is rounded off.

[P/NP] ..... Switches between print and non print mode. When [P/NP] lock key is off, disables all printing except [PF] or [#/P] key.  
When mode changes from non-print to print, feeds the paper one line.

[IC+] ..... Selects item count mode.

[IC±] IC+ ..... Counts up by the [+] or [-] key.  
IC± ..... Counts up by the [+] key, down by the [-] key.

[Σ] ..... If an operation is performed by the [=] or [%] key in auto accumulation calculation mode, adds the operation result to the addition/subtraction register and increments the item counter.

[GT] ..... In grand total mode, adds the total register to the GT register by the [\*] key.

[T/L] ..... When the [T/L] lock key is off, the [P/NP], [Σ], [GT MOD], [IC MOD], [RND], and [DEC] keys are valid. When the [T/L] key is on, the [NP], [Σ], [GT], [IC+], [IC±], [CUT], [UP], and [0, 1, 2, 3, 4, 6, A, AII] lock keys are valid.

[SET I] ..... When the [SET I / SETII] lock key is on, prints and express the stored tax rate.  
[SETII] ..... When the [SET I / SETII] lock key is off, store the expression data to the new tax rate. The result of tax rate is only floating-point, and not convert the decimal-point at this function.

[FEED] ..... Feed paper.

[TMR] ..... When the [TMR] lock key is on, auto power-off functions.  
(After approx. 6 minutes.)

[2TAX] ..... Switches between single tax and double tax mode.  
When the [2TAX] lock key is on, one tax rate can be set. (SETII and TAXII will be disabled.)  
When the [2TAX] lock key is off, two tax rates can be set.

[2M] ..... Selects single memory or double memory mode.  
When the [2M] lock key is on, one memory can be used. (MII will be disabled.)  
When the [2M] lock key is off, two memories can be used.

#### 4) ON, OFF key

[ON] ..... If pressed in HOLD mode, cancels HOLD. At that time, cancels all arithmetic instructions and errors. The contents of the memory register and the TAX RATE before HOLD mode are retained ; all other registers are cleared. While the [ON] key is pressed, the [OFF] key is invalid.

[OFF] ..... Forcibly enters HOLD mode (CPU sleep mode).

## OPERATION EXAMPLE

KEY		PRINT	DISPLAY
F 4/5	IC $\Sigma$ GT MOD 10/12 2TAX 2M		
F 4/5	OFF OFF OFF CAL 12 ON ON	POWER ON	
		<PF>	
		C	0.
		<PF>	
		1. +	1.
		2. -	-1.
		-1. $\diamond$	-1.
		-1. *	
		<PF>	
		2.	2.
F 4/5	IC+ OFF OFF CAL 12 ON ON	IC/AVE	
		IC/AVE	
		-0.5 *	-0.5
		0.	0.
		1. +	1.
		2. -	-1.
		$\diamond$ 002.....	
		-1. $\diamond$	-1.
		2.	2.
		<PF>	
		-0.5 *	-0.5
		2.	2.
		*	
		002.....	
		-1. *	
		<PF>	
		2.	2.
		IC/AVE	
		IC/AVE	
		-0.5 *	-0.5
		0.	0.
		3. $\times$	3.
		4. $\div$	12.
		=	
		4. =	
		3. *	
		<PF>	
		5. $\times$	3.
		6. %	5.
		0.3 *	
		<PF>	
		+	
		5.3 %	0.3
		<PF>	
		2. $\div$	
		3. %	
		66.6666666666	
		<PF>	
		2. M	66.6666666666
		3. %	2.
		=	

(Note) &lt;PF&gt; .... Paper feed

KEY		PRINT		DISPLAY
F 4/5	IC $\Sigma$ GT MOD 10/12 2TAX 2M	TOUCH		
			0.0618556701 * 2.0618556701 * <PF> 2Δ% 3=	2.0618556701 2.
			2. 3. % =	
			1. 50. % <PF>	50.
			3. 4. ÷ =	3. 12.
			4. 3. + <PF>	3.
			5. 6. % 0.3 <PF>	5.
			0.3 + 5.3 % <PF>	0.3 5.3
			2. 3. % 66.666666666 <PF>	2. 66.666666666
			2. 3. M % 0.0618556701 * 2.0618556701 + <PF>	2. 2.0618556701
			2. 3. % =	2.
			1. 50. + <PF>	50.
			*	
			122.028522336 * <PF>	122.028522336
			2. 3. + T 5. * + <PF>	2. 5. -3. -7. -12.
F 4/5	OFF $\Sigma$ GT CAL 12 ON ON	2+ 3+ *	GT GT GT GT T	

KEY		PRINT			DISPLAY	
F 4/5	IC $\Sigma$ GT MOD 10/12 2TAX 2M	TOUCH				
F 4/5 OFF	$\Sigma$ OFF CAL 12 ON ON	*	-12.	*	+	
		GT	<PF>	T		GT -12.
			-7.	$\diamond$		GT -7.
		GT	-7.	*		
			<PF>			-7.
		MI +	-----1-----	M		
			-7.	+		MI -7.
		5	-----2-----	M		MI 5.
		M II +		5.	+	
			-----1-----	M		MI, M II 5.
		MI $\diamond$		-7.	$\diamond$	MI, M II -7.
			-----1-----	M		
		MI *		-7.	*	
			-----1-----	M		
		M II $\diamond$		-7.	*	
			-----2-----	M		M II -7.
				5.	$\diamond$	
		M II *	-----2-----	M		M II 5.
				5.	M *	
		#/P	<PF>	5.		
		2 #/P	5.	$\diamond$		5.
		#/P	#2.....			2.
		0 $\div$	2.	$\diamond$		2.
		=	0.	$\div$		0.
			0.	=		0.
			.....			
			0.	*		
		C	<PF>	0.	C	E 0.
			0.	C		0.
			<PF>			
			-----1-----	0.	%	
			<PF>			0.
		3	-----1-----	3.	%	
			<PF>	0.	C	0.
		C	<PF>			0.

KEY								PRINT			DISPLAY	
F	4/5	IC	$\Sigma$	GT	MOD	10/12	2TAX	2M	TOUCH			
F	CUT	OFF	OFF	OFF	SET I	12	ON	ON		-----1-----		
										3.	%	
										<PF>		3.
F	CUT	OFF	OFF	OFF	CAL	12	ON	ON		-----2-----		
F	CUT	OFF	OFF	OFF	SET II	12	ON	ON		0.	%	
										<PF>		0.
F	CUT	OFF	OFF	OFF	CAL	12	ON	ON		-----2-----		
										5.	%	
										<PF>		0.
F	CUT	OFF	OFF	OFF	SET II	12	ON	ON		-----2-----		
										5.	%	
F	CUT	OFF	OFF	OFF	CAL	12	ON	ON		<PF>		
										5.		
										1560.		
										+TAX I		
										-----1-----		
										1560.		
											%	
										46.8	◇	
										1606.8	*	
										<PF>		
										1,606.8		1,606.8
										+TAX II		
										-----2-----		
										1560.		
											%	
										78.	◇	
										1638.	*	
										<PF>		
										1,638.		1,638.
										+TAX I		
										-----1-----		
										1638.	◇	
											%	
										49.14	◇	
										1687.14	*	
										<PF>		
										1,687.14		1,687.14
										+TAX I		
										-----1-----		
										1560.	x	
												1,560.
												1,560.
												78,900.
F	4/5	OFF	OFF	OFF	CAL	12	ON	ON		78900		
										+TAX I		
										-----1-----		
										78900.	=	
										123084000.	◇	
											%	
										369520.	◇	
										126776520.	*	
										<PF>		
										126,776,520.		

KEY		PRINT	DISPLAY
F 4/5	IC $\Sigma$ GT MOD 10/12 2TAX 2M		
		=	126,776,520.
		5	5.
		x	5.
		+TAX I	5.
		=	5.
		5.	=
		25.	*
		<PF>	25.
		-----1-----	
		25.	◇
			%
		0.75	◇
		25.75	*
		<PF>	25.75
		=	25.75
		C	0.
		0.	C
		<PF>	0.
2 CUT OFF OFF OFF	CAL 12 ON ON	1560	1,560.
		+	1,560.00
		1100	1,100.
		+	2,660.00
		+TAX II	-----2-----
		2660.00	◇
			%
		133.00	◇
		2793.00	*
		<PF>	2,793.00
F CUT OFF OFF OFF	CAL 12 ON ON	+TAX I	-----1-----
		2793.00	◇
			%
		83.79	◇
		2876.79	*
		<PF>	2,876.79
		980000	
		000000	980,000,000,000.
		+TAX I	-----1-----
		980000000000.	
			%
		294000000000.	◇
		1.009400000000	*
		<PF>	
		C	1.009400000000
		0.	E
		<PF>	0.
		1560	1,560.
		+/	-1,560.
		+TAX I	-----1-----

KEY						PRINT	DISPLAY
F 4/5	IC	$\Sigma$	GT	MOD	10/12 2TAX 2M		
						-1560.	
						%	
						-46.8	◇
						-1606.8	*
						<PF>	
						1560.	-1,606.8
						-----1-----	1,560.
						1560.	
						%	
						-45.43689321	◇
						1514.56310679	*
						<PF>	
						-----1-----	1,514.56310679
						1514.56310679	◇
						%	
						-44.11348855	◇
						1470.44961824	*
						<PF>	
						1560.	1,470.44961824
						-----2-----	1,560.
						1560.	
						%	
						-74.28571429	◇
						1485.71428571	*
						<PF>	
						-----2-----	1,485.71428571
						1485.71428571	◇
						%	
						-70.74829932	◇
						1414.96598639	*
						<PF>	
						-----1-----	1,414.96598639
						3.	3.
						<PF>	0.
						-----1-----	
						0.	
						<PF>	
						-----1-----	0.
						0.	
						<PF>	
						1234.	0.
						-----1-----	1234.
						1234.	0.
						<PF>	
						-----2-----	
						5.	
						%	
F CUT OFF OFF OFF SET I	12	ON	ON				
F CUT OFF OFF OFF CAL	12	ON	ON				
F CUT OFF OFF OFF SET I	12	ON	ON				
F CUT OFF OFF OFF CAL	12	ON	ON				
F CUT OFF OFF OFF SET II	12	ON	ON				

KEY							PRINT			DISPLAY	
F	4/5	IC	$\Sigma$	GT	MOD	10/12	2TAX	2M	TOUCH		
F	CUT	OFF	OFF	OFF	CAL	12	ON	ON	C	<PF>	5.
										-----2-----	0.
										0.	%
										<PF>	0.
										980000	980,000,000,000.
										000000	
										+TAX I	
										-----1-----	
										980000000000.	
										.....	
										0.	*
										<PF>	E
										0.	0.
A	CUT	OFF	OFF	OFF	CAL	12	ON	ON	C	0.	123.
										+	1.23
										456	456.
										+	5.79
										◇	5.79
										*	5.79
										<PF>	5.79
A II	CUT	OFF	OFF	OFF	CAL	12	ON	ON	789	789.	789.
									x		
									100		100.
									=		
										1.00	=
										789.00	*
										<PF>	789.00

MAXIMUM RATINGS ( $V_{SS} = 0V$ )

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage 1	$V_{DD}$	-0.3~6	V
Supply Voltage (LCD Drive)	$V_{LC}$	-0.3~ $V_{DD} + 0.3$	V
Input Voltage	$V_{IN}$	-0.3~ $V_{DD} + 0.3$	V
Output Voltage	$V_{OUT}$	-0.3~ $V_{DD} + 0.3$	V
Output Current	$I_{OUT}$	3.2	mA
Power Dissipation	$P_D$	600	mW
Soldering Temperature	$T_{Sld}$	260 (10s)	°C
Storage Temperature	$T_{Stg}$	-55~125	°C
Operating Temperature	$T_{opr}$	0~40	°C

## ELECTRICAL CHARACTERISTICS

RECOMMENDED OPERATING CONDITIONS ( $V_{SS} = 0V$ ,  $T_{opr} = 0\sim40^\circ C$ )

PARAMETER	SYMBOL	TEST CIR-CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Operating Temperature	$T_{opr}$	—	—	0	—	40	°C
Supply Voltage	$V_{DD}$	—	NORMAL	4.5	—	5.5	V
		—	SLOW				
		—	HOLD	2.0			
High-Level Input Voltage (Non-Schmitt Circuit)	$V_{IH1}$	—	$V_{DD} \geq 4.5V$	$V_{DD} \times 0.7$	—	$V_{DD}$	V
High-Level Input Voltage (Schmitt Circuit)	$V_{IH2}$			$V_{DD} \times 0.75$	—	$V_{DD}$	
High-Level Input Voltage	$V_{IH3}$	—	$V_{DD} < 4.5V$	$V_{DD} \times 0.9$	—	$V_{DD}$	
Low-Level Input Voltage (Non-Schmitt Circuit)	$V_{IL1}$	—	$V_{DD} \geq 4.5V$	0	—	$V_{DD} \times 0.3$	V
Low-Level Input Voltage (Schmitt Circuit)	$V_{IL2}$			0	—	$V_{DD} \times 0.25$	
Low-Level Input Voltage	$V_{IL3}$	—	$V_{DD} < 4.5V$	0	—	$V_{DD} \times 0.1$	

DC ELECTRICAL CHARACTERISTICS ( $V_{SS} = 0V$ ,  $T_{opr} = 0\sim40^\circ C$ )

PARAMETER	SYMBOL	TEST CIR-CUIT	TERMINAL	CONDITION	MIN	TYP.	MAX	UNIT	
Hysteresis Voltage (Schmitt Circuit)	$V_{HS}$	—	Hysteresis input	—	—	0.7	—	V	
Input Current	$I_{IN1}$	—	KO port, TEST, RESET, HOLD	$V_{DD} = 5.5V$ $V_{IN} = 5.5/0V$	—	—	$\pm 2$	$\mu A$	
	$I_{IN2}$	—	Open drain R port, P port						
Input Resistance	$R_{IN1}$	—	KO port TEST with input resistor	$V_{DD} = 5.5V$ $V_{IN} = 5.5/0V$	30	70	150	$k\Omega$	
	$R_{IN2}$	—	RESET, HOLD		100	220	450		
Output Leakage Current	$I_{LO1}$	—	Sink open drain R port	$V_{DD} = 5.5V$ $V_{OUT} = 5.5V$	—	—	2	$\mu A$	
	$I_{LO2}$	—	Source open drain R port, P port	$V_{DD} = 5.5V$ $V_{OUT} = -1.5V$	—	—	-2		
High-Level Output Voltage	$V_{OH}$	—	Source open drain R port, P port	$V_{DD} = 5.5V$ $I_{OH} = -3.0mA$	2.4	—	—	V	
Low-Level Output Voltage	$V_{OL}$	—	Sink open drain R port	$V_{DD} = 5.5V$ $I_{OL} = 1.6mA$	—	—	0.4	V	
Pull-Down Resistance	$R_{OUT}$	—	R port, P port	$V_{DD} = 5.5V$ $V_{IN} = 5.5V$	30	70	150	$k\Omega$	
Output Resistance	$R_{OS}$	—	SEG	$V_{DD} = 5V$ $V_{DD} - VLC = 3V$	—	—	35	$k\Omega$	
	$R_{OC}$	—	COM		3.8	4.0	4.2		
Output Voltage	$V_{O2/3}$	—	SEG / COM		3.3	3.5	3.7	V	
	$V_{O1/2}$				2.8	3.0	3.2		
	$V_{O1/3}$				—	—	—		
Supply Current (Normal)	$I_{DD}$	—	—	$V_{DD} = 5.5V$ , $V_{LC} = V_{SS}$ $f_C = 4MHz$	—	3	6	mA	
Supply Current (Slow)	$I_{DDS}$	—	—	$V_{DD} = 3.0V$ , $V_{LC} = V_{SS}$ $f_S = 32.768kHz$	—	30	60	$\mu A$	
Supply Current (Hold)	$I_{DDH}$	—	—	$V_{DD} = 5.5V$	—	0.5	10	$\mu A$	

(Note 1) Typ. values are guaranteed at  $T_{opr} = 25^\circ C$ ,  $V_{DD} = 5V$ .

(Note 2)  $I_{IN1}$  : excepts a current through a internal Pull up / down Resistor.

(Note 3)  $R_{OS}$ ,  $R_{OC}$  : Shows On-Resistor at level switching.

(Note 4)  $V_{O2/3}$  : Shows 2/3 Level Output Voltage at which 1/4 or 1/3 duty LCD drive.

(Note 5)  $V_{O1/2}$  : Shows 1/2 Level Output Voltage at which 1/2 duty or static LCD drive.

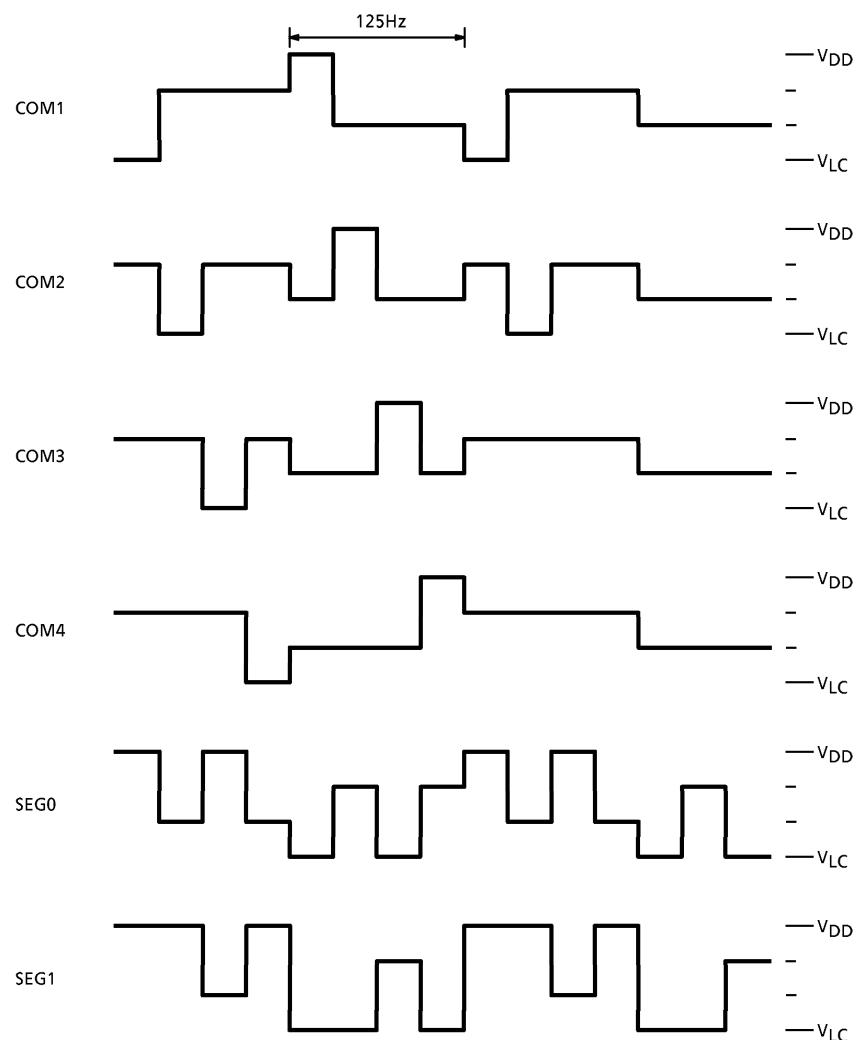
(Note 6)  $V_{O1/3}$  : Shows 1/3 Level Output Voltage at which 1/4 or 1/3 duty LCD drive.

(Note 7)  $I_{DD}$ ,  $I_{DDH}$  : Current consumption at  $V_{IN} = 5.3V/0.2V$   
should be under that KO port is open and R port Voltage Level is valid.

OSCILLATION CIRCUIT ( $V_{SS} = 0V$ ,  $V_{DD} = 4.5\sim 5.5V$ ,  $T_{opr} = 0\sim 40^\circ C$ )

RECOMMENDED CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
	$V_{DD} = 5.0V$ $C = 100pF$ $R = 1k\Omega \pm 2\%$	2.4	4.0	5.6	MHz
	$C = 10pF (XIN), 22pF (XOUT)$ $X'tal = 32.768kHz$	—	32.768	—	KHz

## WAVEFORMS FOR DISPLAY

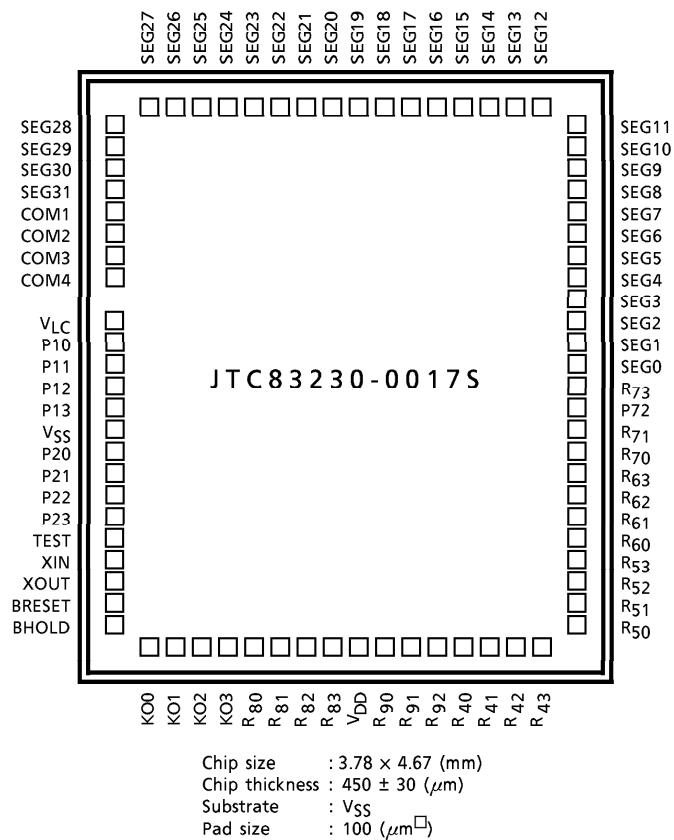


## PAD LOCATION TABLE

NAME	X POINT	Y POINT
K00	-1282	-2074
K01	-1122	-2074
K02	-962	-2074
K03	-802	-2074
R <sub>80</sub>	-641	-2074
R <sub>81</sub>	-438	-2074
R <sub>82</sub>	-278	-2074
R <sub>83</sub>	-74	-2074
V <sub>DD</sub>	86	-2074
R <sub>90</sub>	246	-2074
R <sub>91</sub>	449	-2074
R <sub>92</sub>	610	-2074
R <sub>40</sub>	802	-2074
R <sub>41</sub>	962	-2074
R <sub>42</sub>	1122	-2074
R <sub>43</sub>	1282	-2074
R <sub>50</sub>	1644	-2011
R <sub>51</sub>	1644	-1807
R <sub>52</sub>	1644	-1647
R <sub>53</sub>	1644	-1444
R <sub>60</sub>	1644	-1283
R <sub>61</sub>	1644	-1080
R <sub>62</sub>	1644	-920
R <sub>63</sub>	1644	-716
R <sub>70</sub>	1644	-556
R <sub>71</sub>	1644	-353
R <sub>72</sub>	1644	-193
R <sub>73</sub>	1644	62
SEG0	1644	223
SEG1	1644	383
SEG2	1644	543
SEG3	1644	703
SEG4	1644	863
SEG5	1644	1024
SEG6	1644	1184
SEG7	1644	1344
SEG8	1644	1504
SEG9	1644	1664
SEG10	1644	1825
SEG11	1644	1985

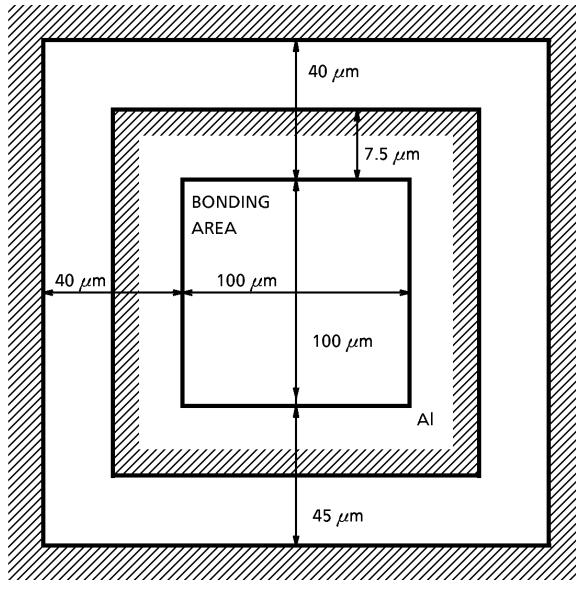
NAME	X POINT	Y POINT	( $\mu$ m)
SEG12	1202	2074	
SEG13	1042	2074	
SEG14	881	2074	
SEG15	721	2074	
SEG16	561	2074	
SEG17	401	2074	
SEG18	241	2074	
SEG19	80	2074	
SEG20	-80	2074	
SEG21	-240	2074	
SEG22	-400	2074	
SEG23	-560	2074	
SEG24	-721	2074	
SEG25	-881	2074	
SEG26	-1041	2074	
SEG27	-1201	2074	
SEG28	-1644	1961	
SEG29	-1644	1801	
SEG30	-1644	1641	
SEG31	-1644	1481	
COM1	-1644	1321	
COM2	-1644	1160	
COM3	-1644	1000	
COM4	-1644	840	
V <sub>LC</sub>	-1644	520	
P10	-1644	359	
P11	-1644	156	
P12	-1644	-4	
P13	-1644	-208	
V <sub>SS</sub>	-1644	-368	
P20	-1644	-528	
P21	-1644	-731	
P22	-1644	-892	
P23	-1644	-1095	
TEST	-1644	-1255	
XIN	-1644	-1415	
XOUT	-1644	-1651	
BRESET	-1644	-1811	
BHOLD	-1644	-1971	

## CHIP LAYOUT



## PAD LAYOUT

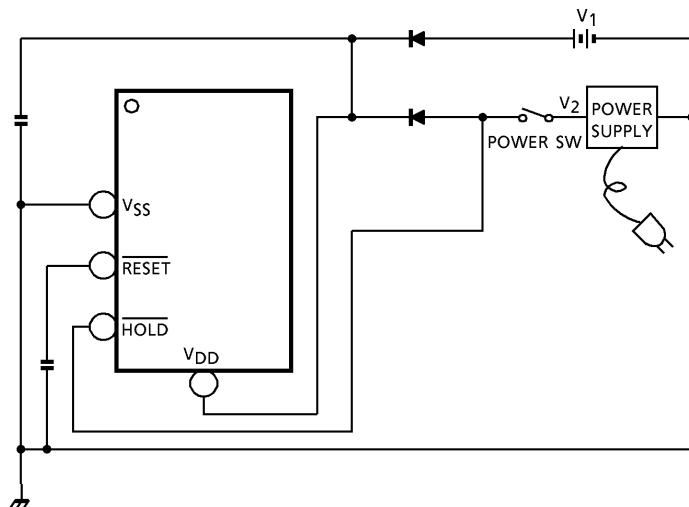
## ACTIVE ELEMENT



## SCRIBE LINE

PAD Pitch : 160 μm

## THE PROPOSAL OF OUTER CIRCUIT FOR TAX RATE HOLDING WITH BACK-UP BATTERY.



(Note)

$V_1 = +3V$  : battery supply

$V_2 = +5V$  : DC supply

(HOLD pin is pulled down in the LSI, but normally pulled up to  $V_{DD}$ .  
RESET pin is pulled up to  $V_{DD}$ . )

- ① Setting POWER SW to ON,  $V_2$  is supplied to  $V_{DD}$  pin, and also to  $\overline{HOLD}$  pin.  
Then calculator operates normally.
- ② Setting POWER SW from ON to OFF,  $V_1$  is supplied to  $V_{DD}$  pin and  $V_{SS}$  is supplied to  $\overline{HOLD}$  pin.  
Under this connection, TAX RATE is held.
- ③ Setting POWER SW to ON,  $V_2$  is supplied to  $V_{DD}$  pin, and also to  $\overline{HOLD}$  pin.  
Then calculator operates normally with TAX RATE to be held.

<NOTE>

$V_1$  (battery) should be supplied to the circuit after  $V_2$  (DC) supply, because of prevention from exhaustion of battery and abnormal operation.

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000707EBA

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