

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC83230-0011, JTC83230-0011S

TC83230-0011, JTC83230-0011S: Single-Chip CMOS LSI for Calculators with Printers  
(applicable printer heads: M-31 manufactured by EPSON)

The TC83230-0011, JTC83230-0011S 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-digit display, two-memory function, serial printer used to print calculation results, oscillator, and LCD drivers.

## Features

### Operational Features

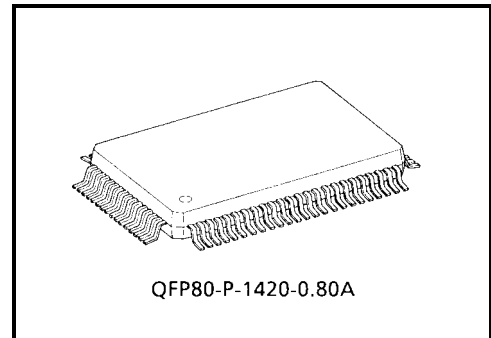
- Print: 11 digits of data. (including decimal point.)
  - 1 digit of minus sign, operational symbol.
  - 1-color printing (black).
- Display: 10 digits of data. (including punctuation in each digit.)
  - 1 digit of floating minus sign, memory load, error symbol, grand total memory load, 3 digits of commas.
- Decimal output: Decimal set lock key controls output format. Fixed decimal setting ("0", "1", "2", "3", "4", "6"), full floating decimal, and ADD 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, square 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

- (1) In the overflow condition, all key except "C", "C/CE", "CE", "Feed", "→" key are inoperative.
- (2) Key chatter protection (at  $f = 4$  MHz)

### Auto-Clear at Power On

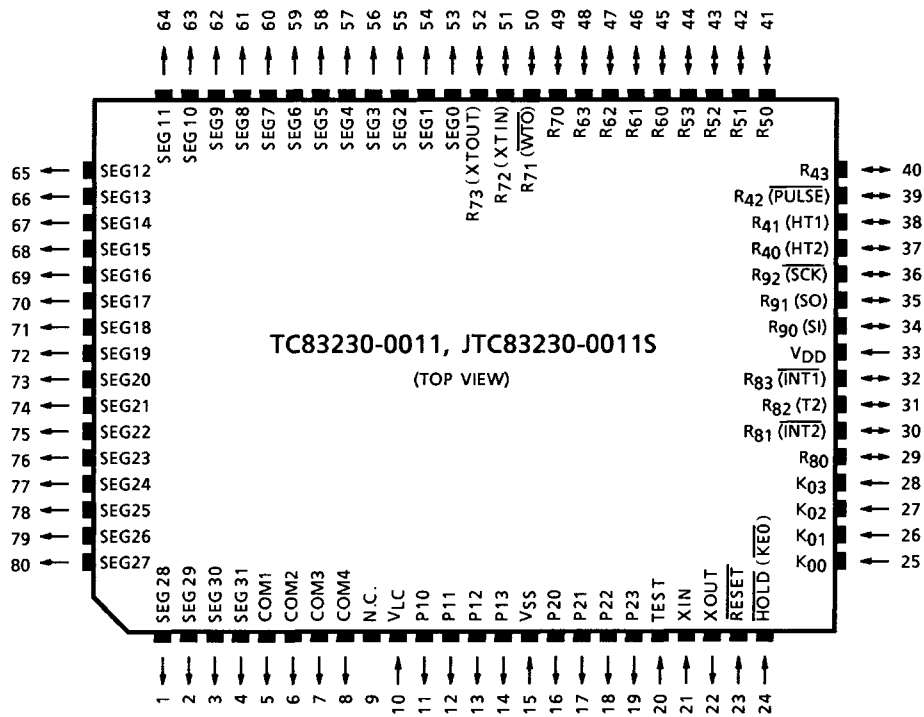
Auto-clear functions by connecting a capacitor to the RESET pin.



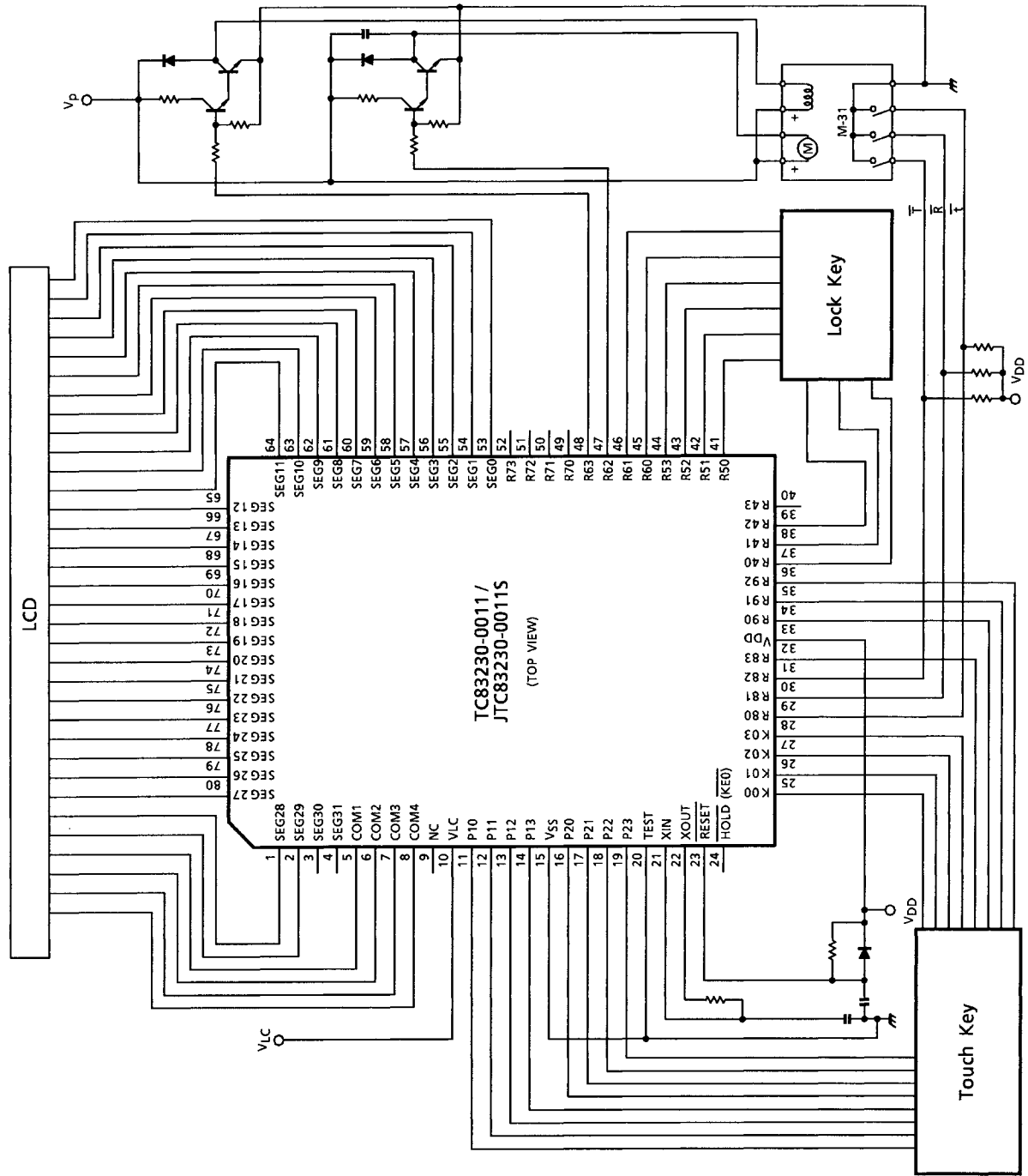
Weight: 1.52 g (typ.)

## Pin Assignment (top view)

QFP80

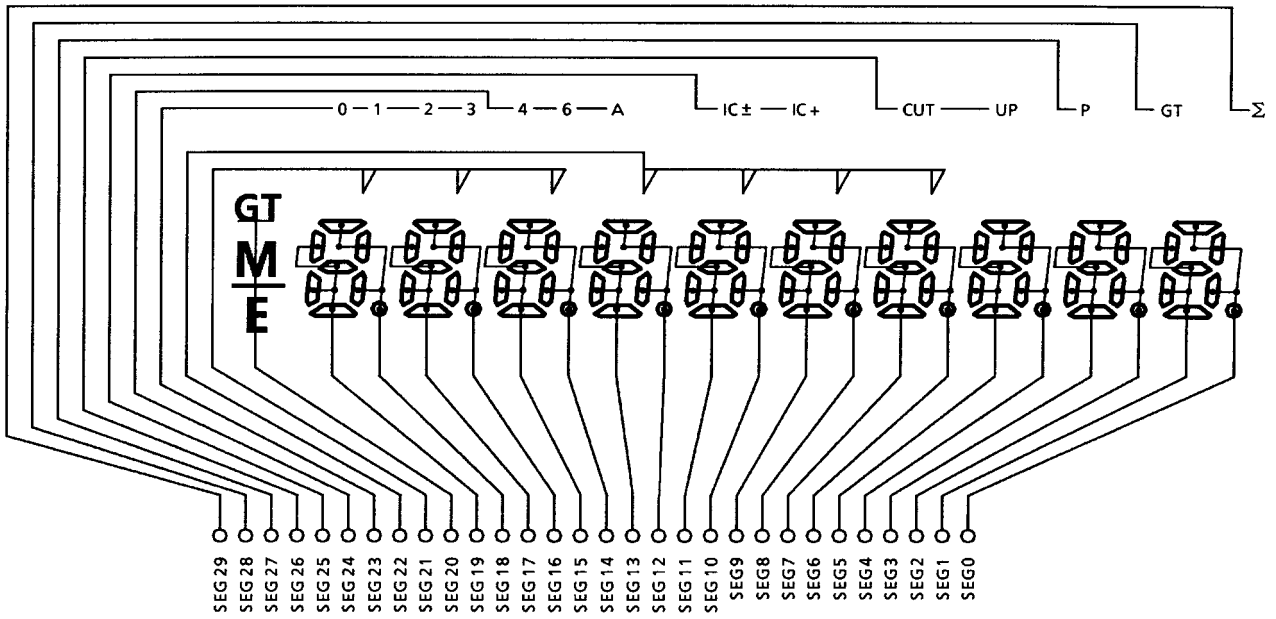


System Block Diagram

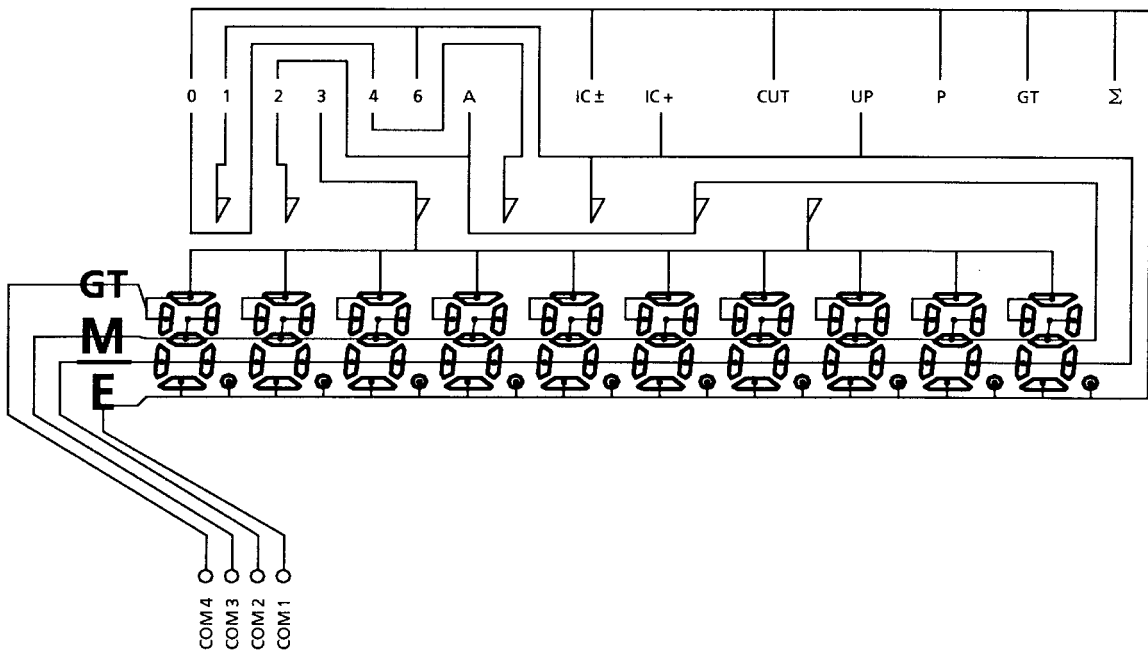


## Connection of LCD

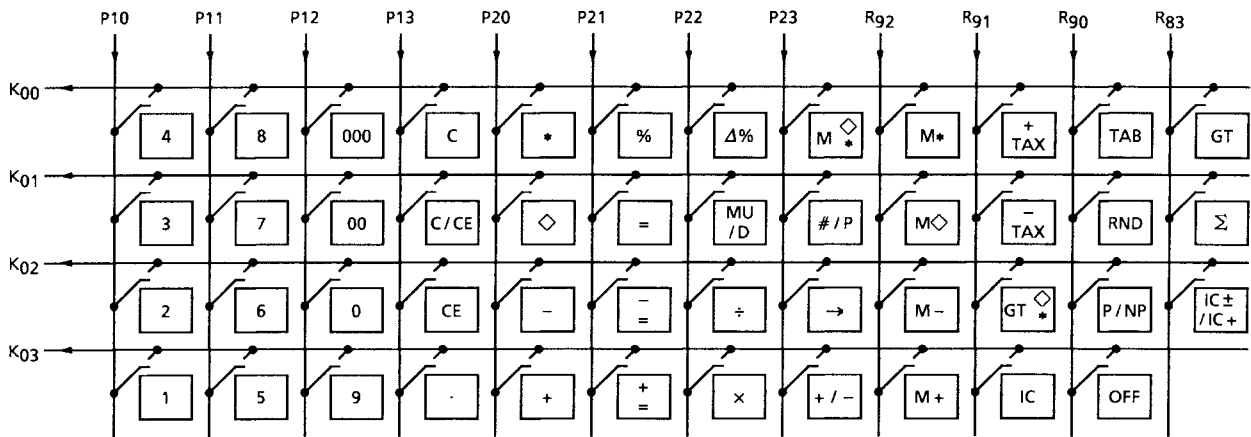
### Segment



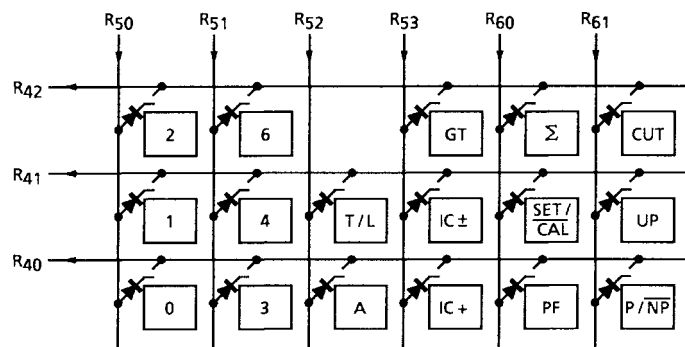
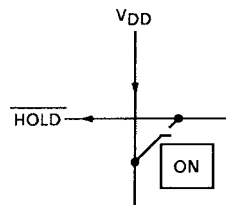
### Common



**Key Connection**



**Touch Key**



**Lock Key**

## Specification of Calculator

### Operation Specifications

(1) Operations depending on key types and modes

Key Name	CAL Mode	Tax Set Mode
Mode switch	[CAL] lock key is on	[SET] lock key is on.
C	Operates as clear key	Clears input data
CE	Operates as clear entry key	Clears input data
C/CE	Operates as clear or clear entry key	Clears input data
OFF	Operates as off key	Unused
Numeral	Numerals Key-inputs numerals	Inputs numerals
.	Key-inputs decimal points	Key-inputs decimal points
$\diamond$ *, $\diamond$	Operates as total or sub-total key	Unused
$\diamond$ +, - $\diamond$ $\times$ , $\div$	Operates as four-function key	Unused
=	Operates as = key	Unused
$\diamond$ GT *	Operates as GT * key	Unused
P/NP	Switches print or non-print	Unused
RND	Switches round-off and round-up	Unused
TAB	Switches decimal points	Unused
%	Operates as % key	Unused
$\Delta$ %	Operates as delta percentage calculation key	Unused
MU/D	Operates as mark-up/down key	Unused
IC	Operates as item count key	Unused
#/P	Operates as non-add-print key for left-justified printing	Unused
$\rightarrow$	Operates as right-shift key	Operates as right-shift key
+/-	Operates as sign change key	Unused
M+, M- M*, M $\diamond$ M* $\diamond$	Operates as memory function key	Unused
+TAX	Operates as +tax key	Unused
-TAX	Operates as -tax key	Unused
$\frac{+}{=}$	Operates as $\frac{+}{=}$ key	Unused
$\frac{-}{=}$	Operates as $\frac{-}{=}$ key	Unused
$\Sigma$	Operates as $\Sigma$ key	Unused
IC $\pm$ /IC+	Operates as IC $\pm$ /IC+ key	Unused
GT	Switches GT-mode or non GT-mode	Unused
PF	Operates as paper feed key	Operates as paper feed key

(2) Explanation of function

[0~9]..... Keys in numbers from 0 to 9, 00, and 000. If the number of display digits exceeds [00, 000] 10 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 display 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

$$\begin{aligned}
 &a \times b\% + \dots a + (ab/100) \\
 &\quad c\% + \dots a + (ac/100) \\
 &a \times b\% - \dots a - (ab/100) \\
 &\quad c\% - \dots a - (ac/100)
 \end{aligned}$$

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+, M-] ..... 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 [×] or [M+, M-] 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◊] ..... 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\*] ..... 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\*] 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.
  
- [M\*◊]..... Operates both [M◊] and [M\*] key operations. Pressing this key once is equivalent to pressing the [M◊] key; pressing the key twice is the same as pressing the [M\*] key.
  
- [×, ÷]..... 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 [×] 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.
  
- [+ -] ..... If the mode is manage of addition or subtraction operation, operation is the same as that for + or - key. And when GT mode is specified, the result of addition/subtraction is added to the GT memory. If the mode is manage of multiplication or division operation, operation is the same as that for = key.
  
- [=]..... 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 [×] or [÷] key performs the following operation.
  - a × =.....aa
  - a ÷ =.....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 [×] or [÷] key performs the following operation.
  - a × % =...aa/100
  - a ÷ % =...100

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

  - a × b%....ab/100
  - +.....a + (ab/100)
  - c% .....ac/100
  - +.....a + (ac/100)
  - a × b%....ab/100
  - .....a - (ab/100)
  - c% .....ac/100
  - .....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:

$$\begin{aligned}
 a\text{MU/Db} = & \dots\dots\dots a/(1 - (b/100)) - a && \text{(prints profit)} \\
 & \dots\dots\dots a/(1 - (b/100)) && \text{(mark-up)} \\
 c = & \dots\dots\dots a/(1 - (c/100)) - a && \text{(prints profit)} \\
 & \dots\dots\dots a/(1 - (c/100)) && \text{(mark-up)} \\
 a\text{MU/Db +/-} = & \dots\dots\dots a/(1 + (b/100)) - a && \text{(prints profit)} \\
 & \dots\dots\dots a/(1 + (b/100)) && \text{(mark-down)} \\
 c +/- = & \dots\dots\dots a/(1 + (c/100)) - a && \text{(prints profit)} \\
 & \dots\dots\dots a/(1 + (c/100)) && \text{(mark-down)}
 \end{aligned}$$

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

Δ%key operation example:

$$\begin{aligned}
 a\Delta\% b = & \dots\dots\dots b - a \\
 & \dots\dots\dots (b - a)/|a| && \text{(prints difference)} \\
 c = & \dots\dots\dots c - a && \text{(change delta percent)} \\
 & \dots\dots\dots (c - a)/|a| && \text{(prints difference)} \\
 a\Delta\% b +/- = & \dots\dots\dots -(b + a) && \text{(change delta percent)} \\
 & \dots\dots\dots -(b + a)/|a| && \text{(prints difference)} \\
 c +/- = & \dots\dots\dots -(c + a) && \text{(change delta percent)} \\
 & \dots\dots\dots -(c + a)/|a| && \text{(prints difference)}
 \end{aligned}$$

[+/-]..... 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.

[IC]..... Calls the contents of the item counter. Does not change current state.

[GT<sup>◇</sup> \*] ..... 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 display; 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+] [M-] [M◇] [M\*] [M\*◇] [MU/D] [IC].  
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±]                    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.

[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+] [M-] [M◇] [M\*] [M\*◇] [MU/D] [IC].  
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.
- [TAX+]  
[TAX-] ..... Calculate included tax operation or excluded tax operation. But, only prints and does not express the tax.
- +TAX, -TAX key operation example: (TAX = 3%)
- |        |                           |                |
|--------|---------------------------|----------------|
| a +TAX | ..... a (3/100)           | (prints TAX)   |
|        | a + (a (3/100))           | (included TAX) |
| a -TAX | ..... a - a / (1 + 3/100) | (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 set to T.
- [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 set to T.
- [TAB] ..... Switches the decimal point. At reset, floating point (F) is set. Switches the mode in each time when the [TAB] key is pressed as follows: F → 0 → 1 → 2 → 3 → 4 → 6 → A → F → 0 → 1. Displays the specified decimal point or add mode. Valid only when the [T/L] lock key is set to T.
- (3) Explanation of lock keys
- [0, 1, 2, 3] ..... Sets the specified decimal point. If no specification, floating is set.
- [4, 6, A] ..... 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.
- [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 on, the [P/NP], [RND], and [TAB] keys are valid.  
When the [T/L] key is off, the [NP], [CUT], [UP], and [0, 1, 2, 3, 4, 6, A] lock keys are valid.
- [SET/CAL] ..... When the (SET/CAL) lock key is on, prints and express the stored tax rate.  
When the (SET/CAL) lock key is off, store the expression data to the new tax rate.  
The result of tax rate is only floating-point, and not concent the decimal-point at this function.
- [PF] ..... Feed paper.
- (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
TAB	4/5	IC	Σ	GT	MOD	Touch			
F	4/5	OFF	OFF	OFF	CAL	POWER ON		<PF>	
								C	
								<PF>	0.
						1+		1. +	1.
						2-		2. -	-1.
						◇		-1. ◇	-1.
						*		-1. *	
								<PF>	-1.
						IC		0.	0.
		IC+				1+		1. +	1.
						2-		2. -	-1.
						◇		002.....	
								-1. ◇	-1.
						*		002.....	
								-1. *	
								<PF>	-1.
						IC		0.	0.
						3×		3. ×	3.
						4÷		4. ÷	12.
						=		4. =	
								3. *	
								<PF>	3.
						5×		5. ×	5.
						6%		6. %	
								0.3 *	
								<PF>	0.3
						+		+	
								5.3 %	
								<PF>	5.3
						2÷		2. ÷	2.
						3%		3. %	
								66.66666666 *	
								<PF>	66.66666666
						2 MU/D		2. M	2.
						3=		3. %	
								=	
								0.06185567 *	
								2.06185567 *	
								<PF>	2.06185567
						2Δ%		2. -	2.

Note 1: <PF> .....Paper feed

Key							Touch	Print		Display
TAB	4/5	IC	Σ	GT	MOD					
							3=	3.	%	
								=		
								1.	*	
								50.	*	
								<PF>		50.
F	4/5	OFF	Σ	OFF	CAL		3×	3.	×	3.
							4÷	4.	÷	12.
							=	4.	=	
								3.	+	
								<PF>		3.
							5×	5.	×	5.
							6%	6.	%	
								0.3	+	
								<PF>		0.3
							+	+		
								5.3	%	
								<PF>		5.3
							2÷	2.	÷	2.
							3%	3.	%	
								66.66666666	+	
								<PF>		66.66666666
						2	MU/D	2.	M	2.
							3=	3.	%	
								=		
								0.06185567	*	
								2.06185567	+	
								<PF>		2.06185567
							2Δ%	2.	-	2.
							3=	3.	%	
								=		
								1.	*	
								50.	+	
								<PF>		50.
							*	122.0285223	*	
								<PF>		122.0285223
				GT			2+	2.	+	2.
							3+	3.	+	5.
							*	T		
								5.	+	
								<PF>		5.
							3-	3.	-	-3.
							4-	4.	-	-7.

Note 1: <PF> .....Paper feed

Key							Touch	Print		Display
TAB	4/5	IC	Σ	GT	MOD	Print		Print	Display	
							5-	5. -		-12.
							*	T		
								-12 +		
								<PF>		-12.
							GT	T		
								-7. ◊		-7.
							GT	T		
								-7. *		
								<PF>		-7.
				OFF			M+	M		
								-7. +	M	-7.
F	4/5	OFF	Σ	OFF	CAL		M◊	M		
								-7. ◊	M	-7.
							M*	M		
								-7. *		
								<PF>		-7.
							#/P	-7. ◊		-7.
							2 #/P	#2.....		2.
							#/P	2. ◊		2.
							0÷	0. ÷		0.
							=	0. =		
								.....		
								0. *		
								<PF>	E	0.
							C	0. C		
								<PF>		0.
	CUT		OFF		SET			0. %		
								<PF>		0.
							3			3.
					CAL			3. %		
								<PF>		0.
							C	0. C		
								<PF>		0.
					SET			3. %		
								<PF>		3.
					CAL					0.
							1560			1,560.
							+TAX	1560.		
								%		
								46.8 ◊		
								1606.8 *		

Note 1: <PF> .....Paper feed

Key						Print	Display
TAB	4/5	IC	Σ	GT	MOD		
						<PF>	1,606.8
						+TAX 1606.8 ◊	
						%	
						48.204 ◊	
						1655.004 *	
						<PF>	1,655.004
						1560	1,560.
						x	1,560.
						78900	78,900.
						+TAX 78900. =	
						123084000. ◊	
						%	
						3692520. ◊	
						126776520. *	
						<PF>	126,776,520.
						=	126,776,520.
						5	5.
						x	5.
F	CUT	OFF	OFF	OFF	CAL	+TAX 5. x	5.
						=	5.
						25. *	
						<PF>	25.
						+TAX 25. ◊	
						%	
						0.75 ◊	
						25.75 *	
						<PF>	25.75
						=	25.75
						C	0.
						<PF>	0.
2						1560	1,560.
						+	1,560.00
						1100	1,100.
						+	2,660.00
						+TAX 1100.00 +	
						2660.00 ◊	
						%	
						79.80 ◊	
						2739.80 *	
						<PF>	2,739.80
F						+TAX 2739.80 ◊	
						%	
						82.194 ◊	
						2821.994 *	
						<PF>	2,821.994

Note 1: <PF> .....Paper feed

Key							Print	Display
TAB	4/5	IC	Σ	GT	MOD	Touch		
						98000000		
						00		9,800,000,000.
						+TAX	9800000000. %	
							294000000. ◊ .....	
							1,009400000 * <PF>	E 1,009400000
						C	0. C <PF>	0.
						1560		1,560.
						+/-		-1,560.
						+TAX	-1560. %	
							-46.8 ◊ -1606.8 *	
							<PF>	-1,606.8
						1560		1,560.
						-TAX	1560. %	
							-45,436894 ◊ 1514.563106 *	
							<PF>	1,514.563106
F	CUT	OFF	OFF	OFF	CAL	-TAX	1514.563106 ◊ %	
							-44.11348855 ◊ 1470.449618 *	
							<PF>	1,470.449618
					SET		3. % <PF>	3.
						C		0.
					CAL		0. % <PF>	0.
					SET		0. % <PF>	0.
						1234		1,234.
					CAL		1234. % <PF>	0.
						98000000		
						00		9,800,000,000.
						+TAX	9800000000. 0. *	
							..... <PF>	E 0.
						C	0. C <PF>	0.

Note 1: <PF> .....Paper feed



## Maximum Ratings ( $V_{SS} = 0\text{ V}$ )

Characteristics	Symbol	Rating	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 (10 s)	°C
Storage temperature	$T_{stg}$	-55~125	°C
Operating temperature	$T_{opr}$	0~40	°C

## Electrical Characteristics

### Recommended Operating Conditions ( $V_{SS} = 0\text{ V}$ , $T_{opr} = 0\sim 40\text{°C}$ )

Characteristics	Symbol	Test Circuit	Test Condition	Min	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)	$V_{IH1}$	—	$V_{DD} \geq 4.5\text{ V}$	$V_{DD} \times 0.7$	$V_{DD}$	V
High-level input voltage (schmitt circuit)	$V_{IH2}$			$V_{DD} \times 0.75$	$V_{DD}$	V
High-level input voltage	$V_{IH3}$	—	$V_{DD} < 4.5\text{ V}$	$V_{DD} \times 0.9$	$V_{DD}$	V
Low-level input voltage (non-schmitt circuit)	$V_{IL1}$	—	$V_{DD} \geq 4.5\text{ V}$	0	$V_{DD} \times 0.3$	V
Low-level input voltage (schmitt circuit)	$V_{IL2}$			0	$V_{DD} \times 0.25$	V
Low-level input voltage	$V_{IL3}$	—	$V_{DD} < 4.5\text{ V}$	0	$V_{DD} \times 0.1$	V

## DC Characteristics ( $V_{SS} = 0\text{ V}$ , $T_{opr} = 0\sim 40^{\circ}\text{C}$ )

Characteristics	Symbol	Test Circuit	Terminal	Test 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	$V_{DD} = 5.5\text{ V}$	—	—	$\pm 2$	$\mu\text{A}$
	$I_{IN2}$	—	Open Drain R port, P port	$V_{IN} = 5.5/0\text{ V}$	—	—	$\pm 2$	$\mu\text{A}$
Input resistance	$R_{IN1}$	—	KO port TEST with Input Resistor	$V_{DD} = 5.5\text{ V}$	30	70	150	$\text{k}\Omega$
	$R_{IN2}$	—	RESET, HOLD	$V_{IN} = 5.5/0\text{ V}$	100	220	450	
Output leakage current	$I_{LO1}$	—	Sink Open Drain R port	$V_{DD} = 5.5\text{ V}$ $V_{OUT} = 5.5\text{ V}$	—	—	2	$\mu\text{A}$
	$I_{LO2}$	—	Source Open Drain R port, P port	$V_{DD} = 5.5\text{ V}$ $V_{OUT} = -1.5\text{ V}$	—	—	-2	
High-level output voltage	$V_{OH}$	—	Source Open Drain R port, P port	$V_{DD} = 5.5\text{ V}$ $I_{OH} = -1.6\text{ mA}$	2.4	—	—	V
Low-level output voltage	$V_{OL}$	—	Sink Open Drain R port	$V_{DD} = 5.5\text{ V}$ $I_{OL} = 1.6\text{ mA}$	—	—	0.4	V
Pull-down resistance	$R_{OUT}$	—	R port, P port	$V_{DD} = 5.5\text{ V}$ $V_{IN} = 5.5\text{ V}$	30	70	150	$\text{k}\Omega$
Output resistance	$R_{OS}$	—	SEG	$V_{DD} = 5\text{ V}$ $V_{DD} - V_{LC} = 3\text{ V}$	—	—	35	$\text{k}\Omega$
	$R_{OC}$	—	COM					
Output voltage	$V_{O2/3}$	—	SEG/COM	$V_{DD} = 5\text{ V}$ $V_{DD} - V_{LC} = 3\text{ V}$	3.8	4.0	4.2	V
	$V_{O1/2}$				3.3	3.5	3.7	
	$V_{O1/3}$				2.8	3.0	3.2	
Supply current (normal)	$I_{DD}$	—	—	$V_{DD} = 5.5\text{ V}$ , $V_{LC} = V_{SS}$ $f_c = 4\text{ MHz}$	—	3	6	mA
Supply current (hold)	$I_{DDH}$	—	—	$V_{DD} = 5.5\text{ V}$	—	0.5	10	$\mu\text{A}$

Note 2: Typ. values are guaranteed at  $T_{opr} = 25^{\circ}\text{C}$ ,  $V_{DD} = 5\text{ V}$ .

Note 3:  $I_{IN1}$ : Expects a current through a internal pull up/down resistor.

Note 4:  $R_{OS}$ ,  $R_{OC}$ : Shows on-resistor at level switching.

Note 5:  $V_{O2/3}$ : Shows 2/3 level output voltage at which 1/4 or 1/3 duty LCD drive.

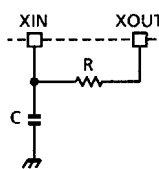
Note 6:  $V_{O1/2}$ : Shows 1/2 level output voltage at which 1/2 duty or static LCD drive.

Note 7:  $V_{O1/3}$ : Shows 1/3 level output voltage at which 1/4 or 1/3 duty LCD drive.

Note 8:  $I_{DD}$ ,  $I_{DDH}$ : Current consumption at  $V_{IN} = 5.3\text{ V}/0.2\text{ V}$

Should be under that KO port is open and R port voltage level is valid.

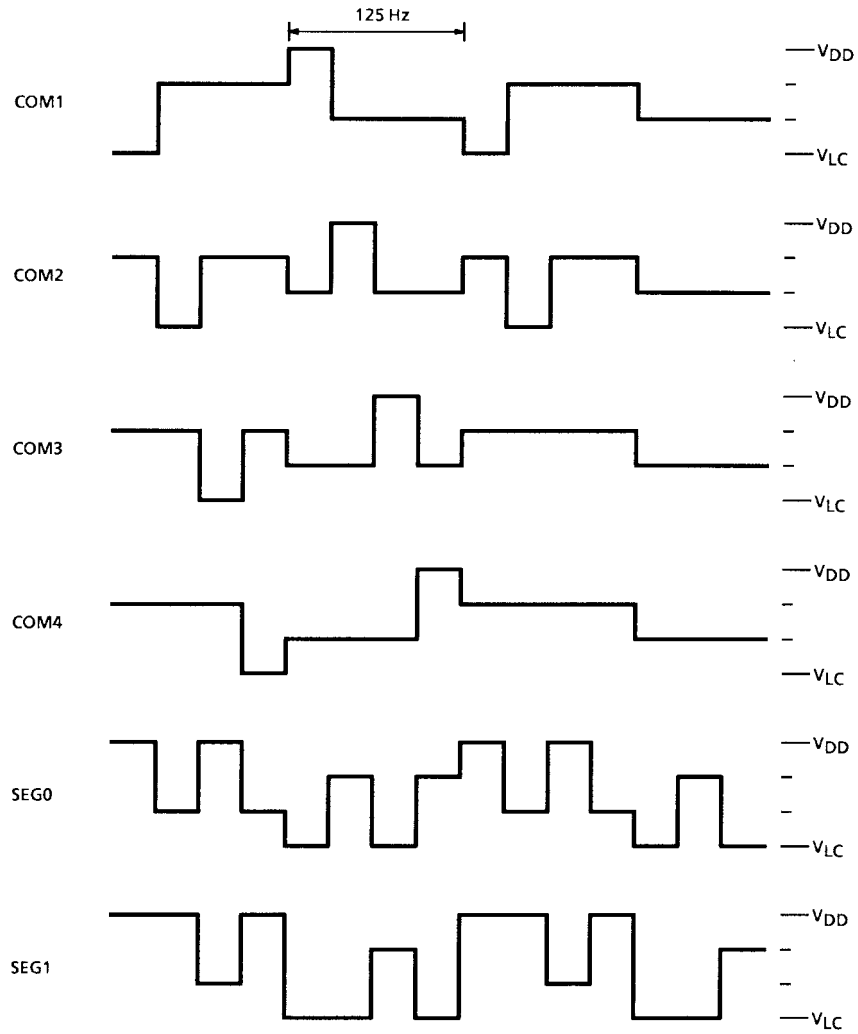
## Oscillation Circuit ( $V_{SS} = 0\text{ V}$ , $V_{DD} = 4.5\sim 5.5\text{ V}$ , $T_{opr} = 0\sim 40^\circ\text{C}$ )

Recommended Circuit	Test Condition	Min	Typ.	Max	Unit
	$V_{DD} = 5.0\text{ V}$ $C = 100\text{ pF}$ $R = 1\text{ k}\Omega \pm 2\%$	2.4	4.0	5.6	MHz

## AC Characteristics ( $V_{SS} = 0\text{ V}$ , $V_{DD} = 4.5\sim 6.0\text{ V}$ , $T_{opr} = 0\sim 40^\circ\text{C}$ )

Characteristics	Symbol	Test Circuit	Test Condition	Min	Typ.	Max	Unit
Instruction cycle time	$t_{CY}$	—	NORMAL	1.9	—	20	$\mu\text{s}$
		—	SLOW	235	—	267	
High-level clock pulse width	$t_{WCH}$	—	External Clock Operation	80	—	—	ns
Low-level clock pulse width	$t_{WCL}$	—					ns
Shift data hold time	$t_{SDH}$	—	—	$0.5 t_{CY}$ – 300	—	—	ns
High speed timer/counter input frequency	$f_{HT}$	—	—	—	—	$f_c$	MHz

**Waveforms for Display**



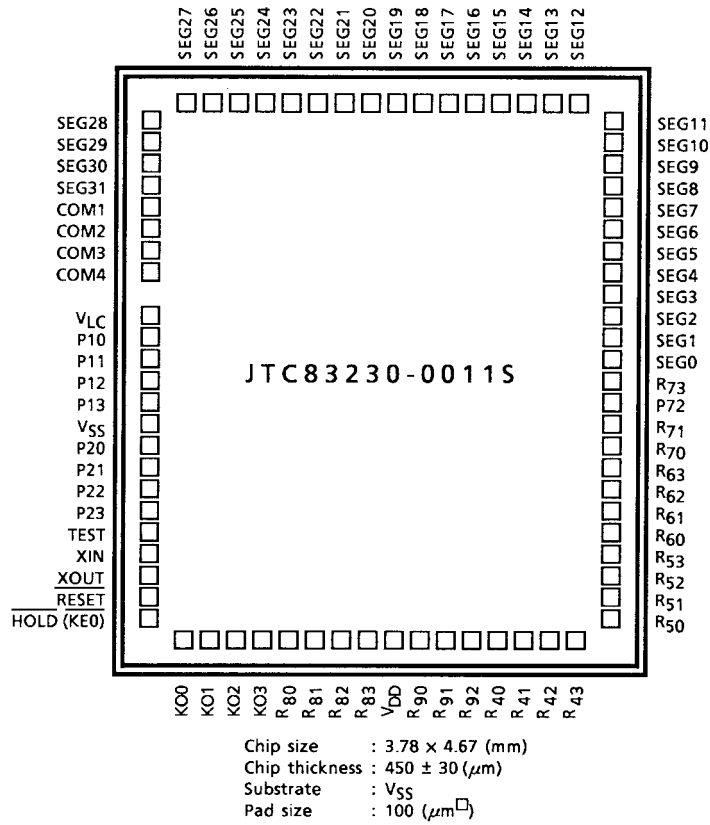
## Pad Location Table

( $\mu\text{m}$ )

Name	X Point	Y Point
KO0	-1282	-2074
KO1	-1122	-2074
KO2	-962	-2074
KO3	-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

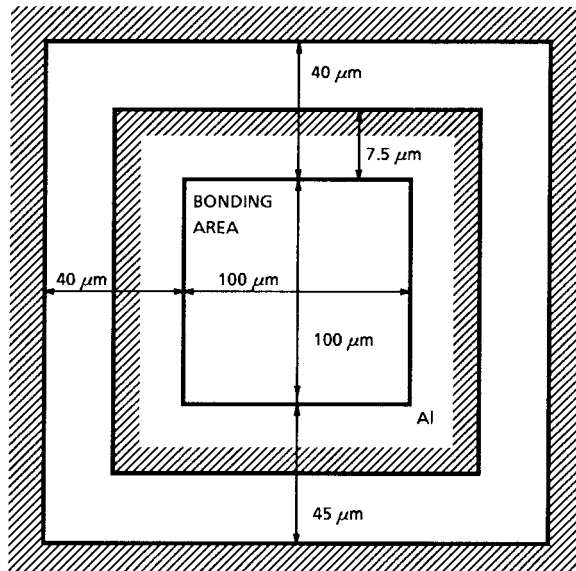
Name	X Point	Y Point
SEG12	1202	2074
SEG13	1042	2074
SEG14	881	2074
SEG15	721	2074
SEG16	561	2074
SEG17	401	2074
SEG18	241	2074
SEG19	80	2074
SEG20	-80	2074
SEG21	-240	2074
SEG22	-400	2074
SEG23	-560	2074
SEG24	-721	2074
SEG25	-881	2074
SEG26	-1041	2074
SEG27	-1201	2074
SEG28	-1644	1961
SEG29	-1644	1801
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**

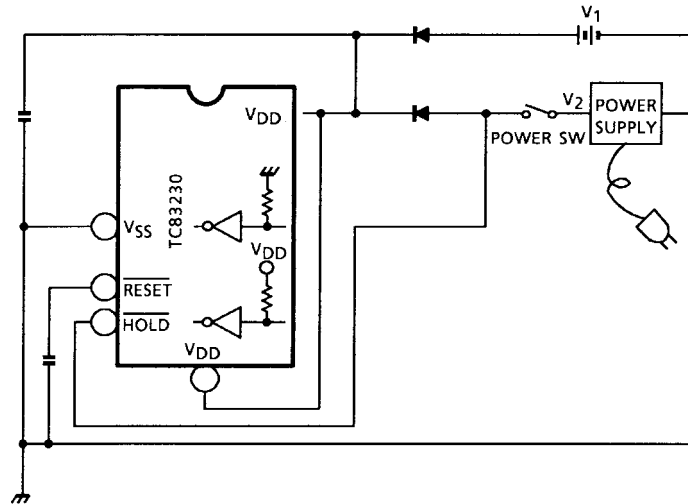
**Active Element**



SCRIBE LINE

Pad pitch 160 (μm)

**The Proposal of Outer Circuit for Tax Rate Holding with Back-Up Battery.**



Note 9:  $V_1 = +3\text{ V}$ : Battery supply

$V_2 = +5\text{ V}$ : DC supply

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

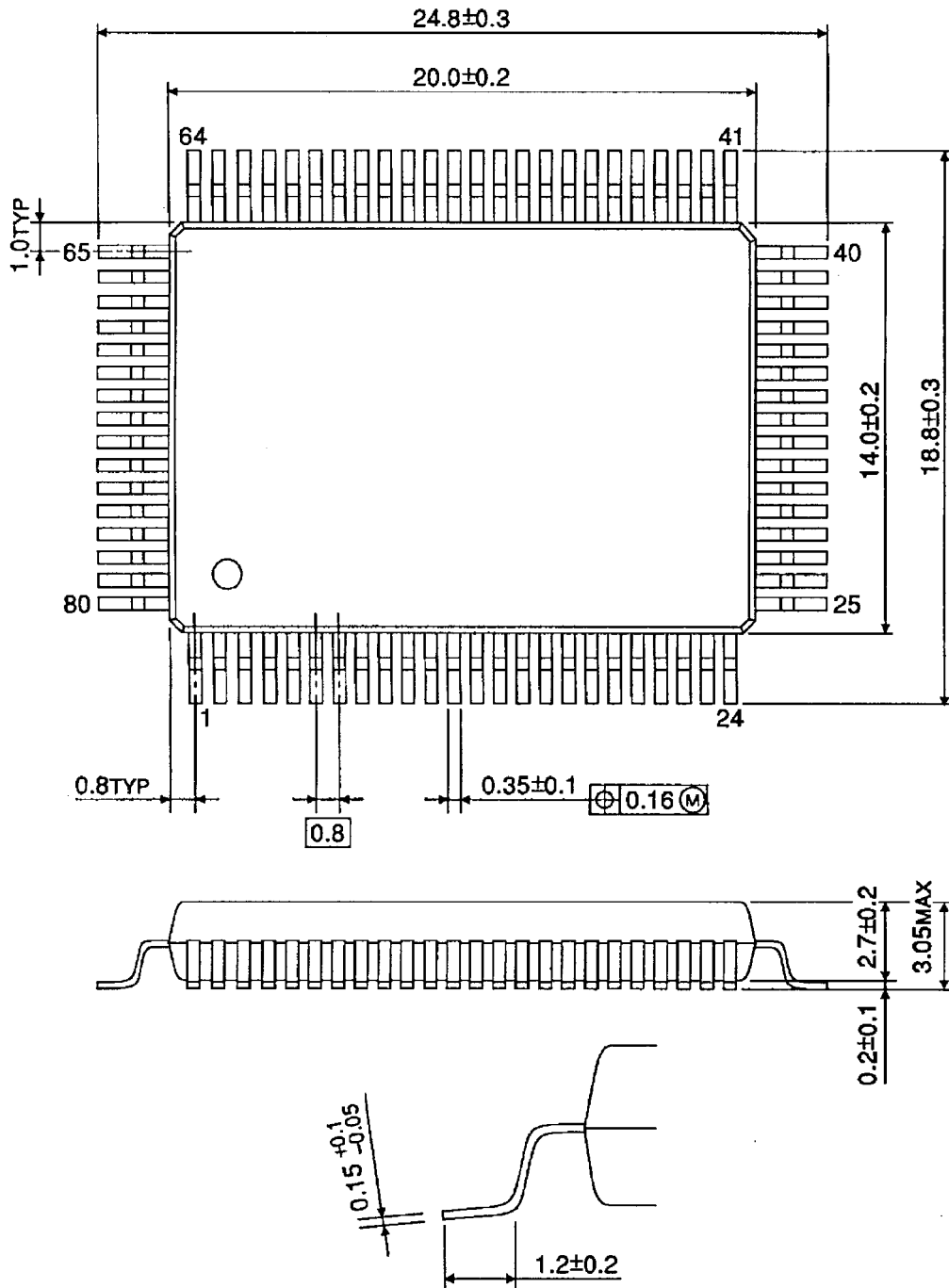
- (1) Setting POWER SW to ON,  $V_2$  is supplied to  $V_{DD}$  pin, and also to  $\overline{\text{HOLD}}$  pin. Then calculator operates normally.
- (2) Setting POWER SW from ON to OFF,  $V_1$  is supplied to  $V_{DD}$  pin and  $V_{SS}$  is supplied to  $\overline{\text{HOLD}}$  pin. Under this connection,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

Note 10:  $V_1$  (battery) should be supplied to the circuit after  $V_2$  (DC) supply, because of prevention from exhaustion of battery and abnormal operation.

**Package Dimensions**

QFP80-P-1420-0.80A

Unit : mm



Weight: 1.52 g (typ.)



**RESTRICTIONS ON PRODUCT USE**

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.  
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.