TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT   SILICON MONOLITHIC

T C 8 3 2 3 0 - 0 0 1 2

TC83230-0012 : SINGLE-CHIP CMOS LSI FOR CALCULATORS WITH PRINTERS
(APPLICABLE PRINTER HEADS : M-80, M-400A, M-400E, M-401A MANUFACTURED BY EPSON)

The TC83230-0012 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- and 12-digit display, two-memory function, parallel printer used to print calculation results, oscillator, and LCD drivers.

* PRINT FONT No. : M400A ··· 001-300
                   M401A ··· 001-331
                   M400E ··· 001-310
                   M80   ··· Type A (12 digits)
                            Type C (10 digits)

QFP80-P-1420-0.80A
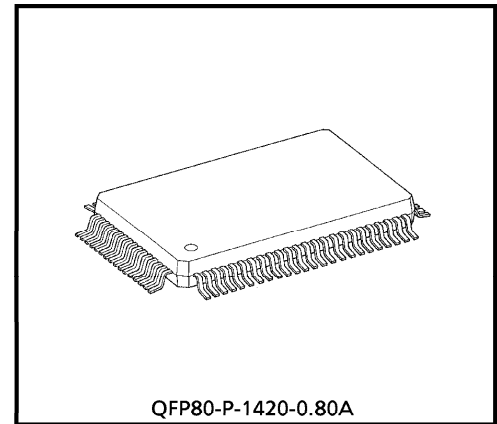
Weight : 1.52 g (Typ.)

FEATURES

Operational Features

- Print — 16 digits of data. (including decimal point.) 2 digits of minus sign, operational symbol. 2-color printing.

- Display — 10 and 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, 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

● 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
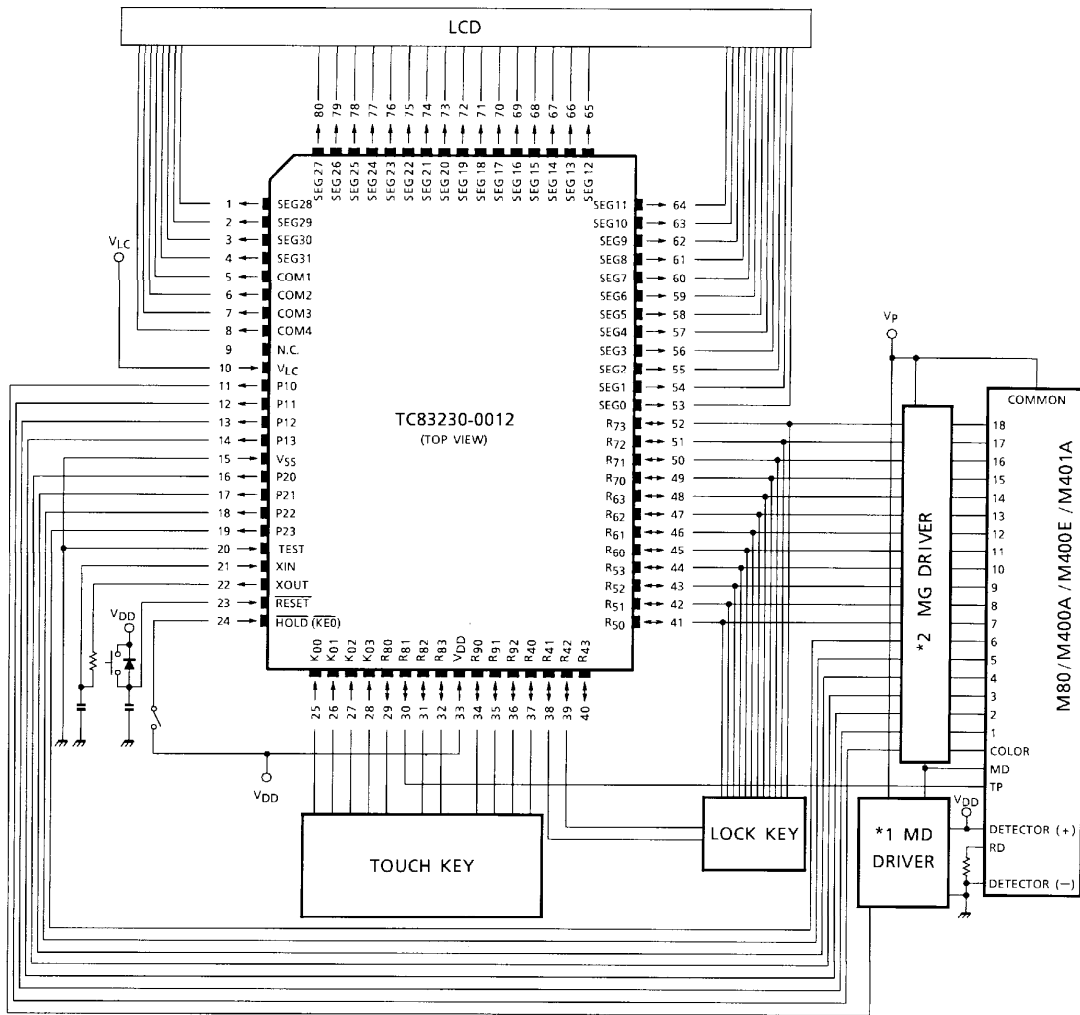
*1 MD DRIVER

*2 MG DRIVER

TC83230-0012－03
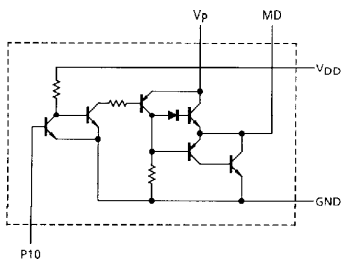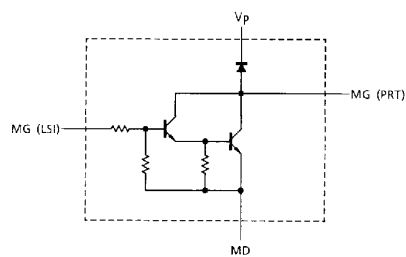
CONNECTION OF LCD

SEGMENT
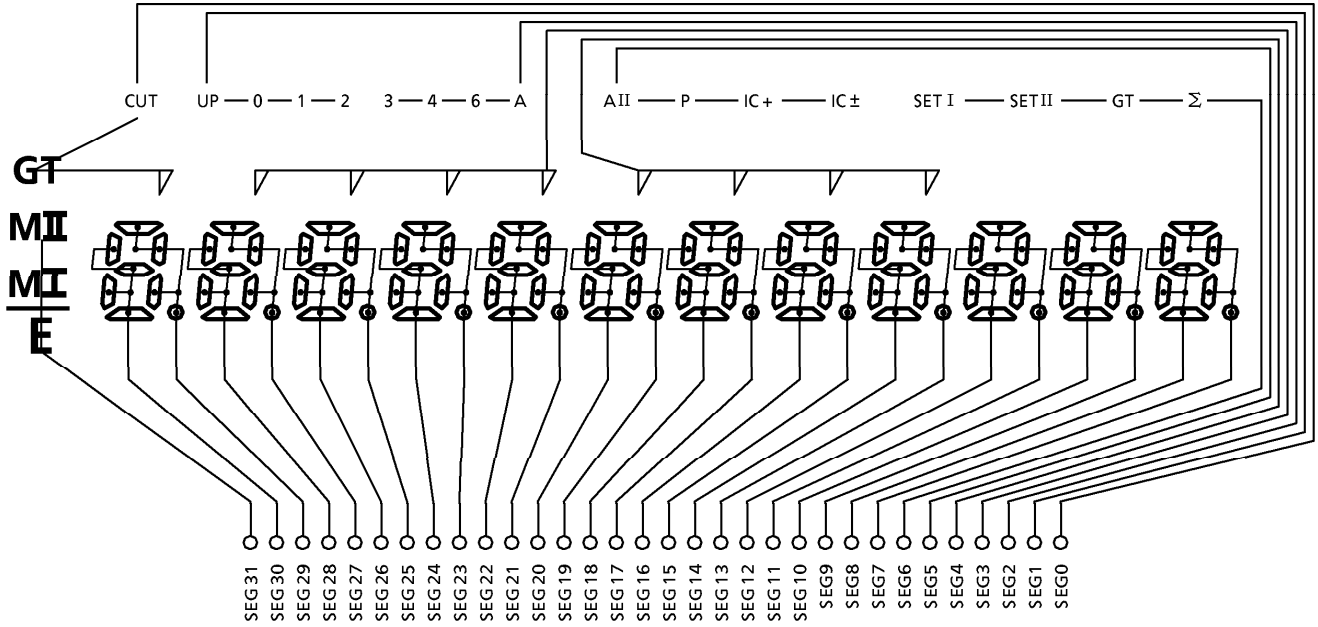
COMMON
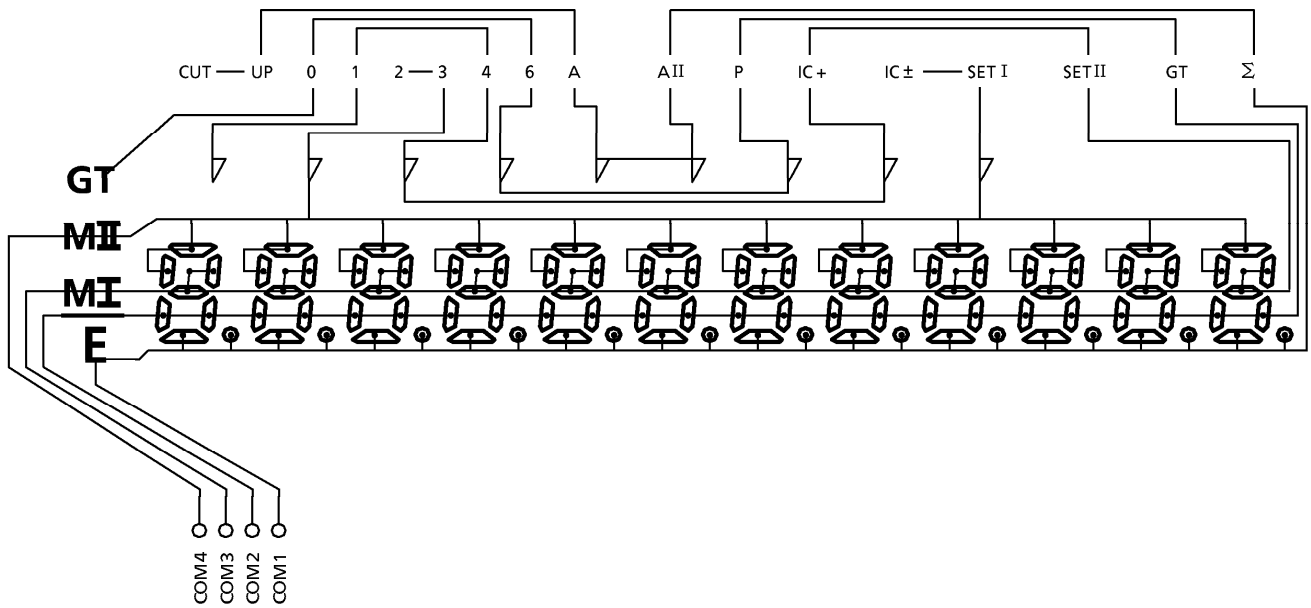
KEY CONNECTION
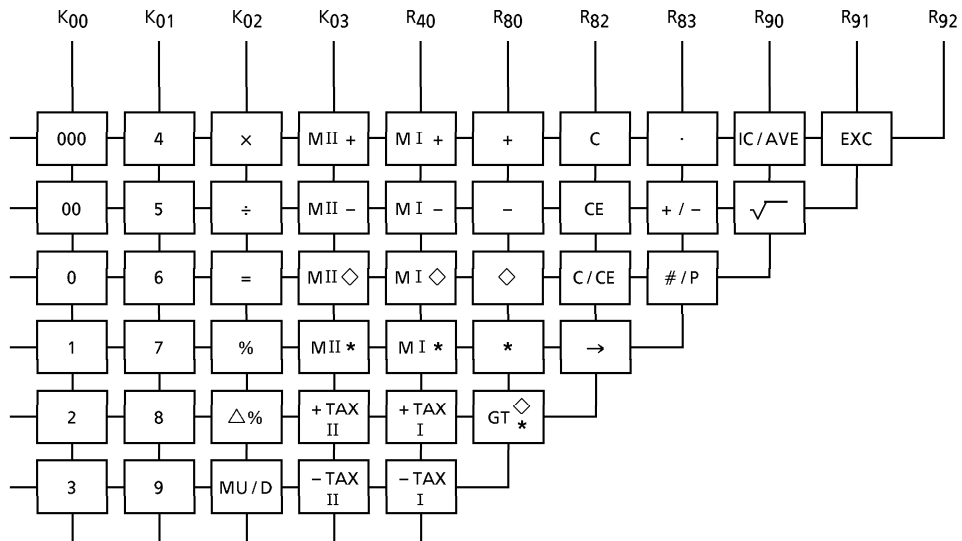
Touch Key
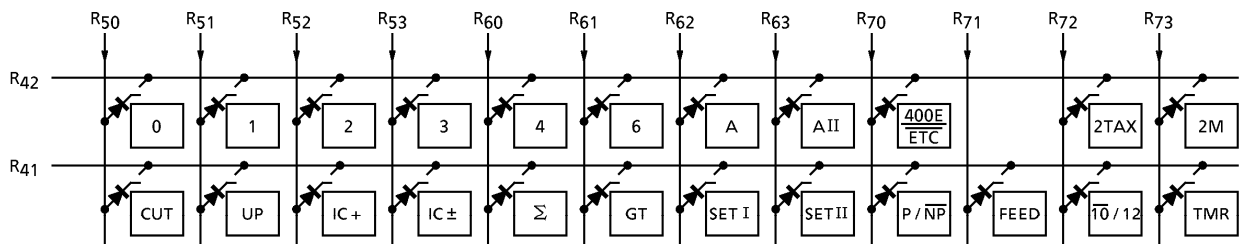
Lock Key

PIN ASSIGNMENT
QFP80

TC83230-0012
(TOP VIEW)

Left side (top to bottom):
65 ← SEG12
66 ← SEG13
67 ← SEG14
68 ← SEG15
69 ← SEG16
70 ← SEG17
71 ← SEG18
72 ← SEG19
73 ← SEG20
74 ← SEG21
75 ← SEG22
76 ← SEG23
77 ← SEG24
78 ← SEG25
79 ← SEG26
80 ← SEG27

Top side (left to right, pins 64–41):
64 SEG11
63 SEG10
62 SEG9
61 SEG8
60 SEG7
59 SEG6
58 SEG5
57 SEG4
56 SEG3
55 SEG2
54 SEG1
53 SEG0
52 R73 (XTOUT)
51 R72 (XTIN)
50 R71 (WTO)
49 R70
48 R63
47 R62
46 R61
45 R60
44 R53
43 R52
42 R51
41 R50

Right side (top to bottom):
40 ↔ R43
39 ↔ R42 (PULSE)
38 ↔ R41 (HT1)
37 ↔ R40 (HT2)
36 ↔ R92 (SCK)
35 ↔ R91 (SO)
34 ↔ R90 (SI)
33 ← VDD
32 ↔ R83 (INT1)
31 ↔ R82 (T2)
30 ↔ R81 (INT2)
29 R80
28 ← K03
27 ← K02
26 ← K01
25 ← K00

Bottom side (left to right, pins 1–24):
1 SEG28
2 SEG29
3 SEG30
4 SEG31
5 COM1
6 COM2
7 COM3
8 COM4
9 N.C.
10 VLC
11 P10
12 P11
13 P12
14 P13
15 VSS
16 P20
17 P21
18 P22
19 P23
20 TEST
21 XIN
22 XOUT
23 RESET
24 HOLD (KE0)

SPECIFICATION OF CALCULATOR
Operation specifications
1) Operations depending on key types and modes
● Touch key

KEY NAME	CAL MODE	TAX SET MODE
Mode switch	[SET] lock key is off.	[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
Numeral	Numerals Key-inputs numerals	Inputs numerals
·	Key-inputs decimal points	Key-inputs decimal points
* ◇	Operates as total or sub-total key	Unused
+, − ×, ÷	Operates as four-function key	Unused
=	Operates as = key	Unused
%	Operates as % key	Unused
⊿%	Operates as delta percentage calculation key	Unused
MU / D	Operates as mark-up / down key	Unused
IC / AVE	Operates as item count or average key	Unused
# / P	Operates as non-add-print key for left-justified printing	Unused
→	Operates as right-shift key	Unused
+ / −	Operates as sign change key	Operates as right-shift key
M I *, M II * M I ◇, M II ◇ M I −, M II − M I +, M II +	Operates as memory function key	Unused
− TAX I / II	Operates as − TAX I / II key	Unused
+ TAX I / II	Operates as + TAX I / II key	Unused
GT ◇ *	Operates as GT key	Unused
EXC	Operates as EXC key	Unused
√	Operates as √ key	Unused

● Lock key

KEY NAME	CAL MODE	TAX SET MODE
Mode switch	[SET] lock key is off.	[SET] lock key is on.
0, 1, 2, 3, 4, 6, A, AⅡ	Switches decimal points	Unused
CUT, UP	Switches round-off and round-up	Unused
IC±, IC+	Operates as IC± / IC+ key	Unused
Σ	Operates as Σ key	Unused
GT	Switches GT mode or non-GT mode	Unused
FEED	Operates as paper feed key	Operates as paper feed key
P / $\overline{\text{NP}}$	Switches print or non-print	Unused
* $\overline{10}$ / 12	Selects 10 or 12 digit	
* $\dfrac{400\text{E}}{\text{ECT}}$	Selects the M400E printer or other printers (M400A, M401A or M80).	
* 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, operating the same as the [$\overline{10}$ / 12] key.

2) Explanation of function

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

                      $a \times b\% \; + \cdots\cdots a + (ab / 100)$
                          $c\% \; + \cdots\cdots a + (ac / 100)$
                      $a \times b\% \; - \cdots\cdots a - (ab / 100)$
                          $c\% \; - \cdots\cdots a - (ac / 100)$

               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.

$\left[\begin{matrix} \text{M I} +, \text{M II} + \\ \text{M I} -, \text{M II} - \end{matrix}\right]$ ... 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 I +, M II +, M I −, M II −] 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 ◇, M II ◇] .. 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 ∗, M II ∗] .... 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 ∗, M II ∗] 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.

[×, ÷] .... 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.

[=] .... 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.

$$a \times \% = \cdots\cdots aa / 100$$
$$a \div \% = \cdots\cdots 100$$

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

$$a \times b\% \cdots\cdots ab / 100$$
$$+ \cdots\cdots\cdots a + (ab / 100)$$
$$c\% \cdots\cdots\cdots ac / 100$$
$$+ \cdots\cdots\cdots a + (ac / 100)$$
$$a \times b\% \cdots\cdots ab / 100$$
$$- \cdots\cdots\cdots a - (ab / 100)$$
$$c\% \cdots\cdots\cdots ac / 100$$
$$- \cdots\cdots\cdots a - (ac / 100)$$

[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 :

$$aMU / Db = \cdots\cdots\cdots a / (1 - (b / 100)) - a \quad \text{(Prints profit)}$$
$$a / (1 - (b / 100)) \quad \text{(Mark-up)}$$
$$c = \cdots\cdots\cdots a / (1 - (c / 100)) - a \quad \text{(Prints profit)}$$
$$a / (1 - (c / 100)) \quad \text{(Mark-up)}$$
$$aMU / Db + / - = \cdots\cdots a / (1 + (b / 100)) - a \quad \text{(Prints profit)}$$
$$a / (1 + (b / 100)) \quad \text{(Mark-down)}$$
$$c + / - = \cdots\cdots a / (1 + (c / 100)) - a \quad \text{(Prints profit)}$$
$$a / (1 + (c / 100)) \quad \text{(Mark-down)}$$

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

Δ%key operation example :

$$aΔ\% \ b = \cdots\cdots b - a$$
$$(b - a) / |a| \quad \text{(Prints difference)}$$
$$c = \cdots\cdots c - a \quad \text{(Change delta percent)}$$
$$(c - a) / |a| \quad \text{(Prints difference)}$$
$$aΔ\% \ b + / - = \cdots\cdots - (b + a) \quad \text{(Change delta percent)}$$
$$- (b + a) / |a| \quad \text{(Prints difference)}$$
$$c + / - = \cdots\cdots - (c + a) \quad \text{(Change delta percent)}$$
$$- (c + a) / |a| \quad \text{(Prints difference)}$$

[+ / −] .... 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◇*] .... 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 +, M II +] [M I −, M II −] [M I ◇, M II ◇] [M I *, M II *] [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 ±]

IC + ········Counts up by the [+] or [−] key.
IC ± ········Counts up by the [+] key, down 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 I +, M II +] [M I −, M II −] [M I ◇, M II ◇] [M I *, M II *] [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 [− TAX II] ..   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.

[EXC] .... If an multiplication or division instruction is not stored in memory, it is invalid. Constant calculation of multiplication or division instruction exchange for the value of displays, and displays it.

[√] .... Operates root-instruction and displays result-value with prints. (Result-value adjusts decimal-point (TAB) setting.)
After prints feeds the paper one line. If the value is minus, change to the plus value and operate root-instruction. Then produce an estimate calculation-error. But keep the arithmetic instruction and date-register.

[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

a (+)		
b (+)		
c (+)	Addition to total	(∗) → Displays or prints addition substraction register.
d (+)	addition substraction register	(IC / AVE) → Displays the item counter
e (+)		(IC / AVE) → Displays or prints
f (+)		$(a + b + c + d + e + f + g) / 7$
g (+)		

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

Example

a (−)		(∗) → Displays or prints addition substraction register.
b (−)	Addition to total addition substraction register	(IC / AVE) → Displays the item counter
c (+)		(IC / AVE) → Displays or prints
d (−)		$(− a − b + c − d) / |4| (IC +)$
		$(− a − b + c − d) / |− 2| (IC ±)$

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 / $\overline{NP}$] .... Switches between print and non print mode. When [P / $\overline{NP}$] 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.

$\begin{bmatrix} \text{SET I} \\ \text{SET II} \end{bmatrix}$ .... When the [SET I / SET II] lock key is on, prints and express the stored tax rate. When the [SET I / SET II] 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.

[FEED] .... Feed paper.

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

[$\overline{10}$ / 12] .... Selects 10 digits display and printer when the [$\overline{10}$ / 12] lock key is off ; Selects 12 digits display and printer when the [$\overline{10}$ / 12] lock key is on.

$\begin{bmatrix} \text{400E} \\ \text{ECT} \end{bmatrix}$ .... Switches between the M400E printer and other printers (M400A, M401A, or M80) to be used.
When the [400E / ECT] lock key is on, selects the M400E printer.
When the [400E / ECT] lock key is off, selects other printers (M400A, M401A, or M80).

[2TAX] .... Switches between single tax and double tax mode.
When the [2TAX] lock key is on, one tax rate can be set. (SET II and TAX II 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. (M II will be disabled.)
When the [2M] lock key is off, two memories can be used.

OPERATION EXAMPLE

KEY										PRINT		DISPLAY
TAB	4/5	IC	Σ	GT	MOD	10/12	2TAX	2M	TOUCH			
F	4/5	OFF	OFF	OFF	CAL	12	OFF	OFF	POWER ON			
										<PF>		
										C		
										<PF>		0.
									1+	1• +		1.
									2−	2• −	R	−1.
									◇	1• − ◇	R	−1.
									∗	1• − ∗	R	
										<PF> −		−1.
									IC/AVE	2•		2.
									IC/AVE	0•5 K ∗	R	−0.5
									IC/AVE	0•		0.
F	4/5	IC+	OFF	OFF	CAL	12	OFF	OFF	1+	1• +		1.
									2−	2• −	R	−1.
									◇	002 1• − ◇	R	−1.
									IC/AVE	2•		2.
									IC/AVE	0•5 K ∗	R	−0.5
									IC/AVE	2•		2.
									∗	002 1• − ∗	R	
										<PF> −		−1.
									IC/AVE	2•		2.
									IC/AVE	0•5 K ∗	R	−0.5
									IC/AVE	0•		0.
F	4/5	OFF	OFF	OFF	CAL	12	OFF	OFF	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•6666666666 ∗		
										<PF>		66.6666666666
									2 MU/D	2• M		2.
									3=	3• %		

(Note) : <PF> ··· Paper feed
         PRINT COLOR ··· R: Red
                   ··· No mark: Black

KEY									TOUCH	PRINT		DISPLAY
TAB	4/5	IC	Σ	GT	MOD	10/12	2TAX	2M				
										0.0618556701 Δ *		
										2.0618556701 *		
										<PF>		2.0618556701
									2Δ%	2· Δ		2.
									3=	3· =		
										1· Δ *		
										50· Δ %		
										<PF>		50.
F	4/5	OFF	Σ	OFF	CAL	12	OFF	OFF	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· %		
										66·6666666666 +		
										<PF>		66.6666666666
									2 MU/D	2· M		2.
									3=	3· %		
										0.0618556701 Δ *		
										2.0618556701 +		
										<PF>		2.0618556701
									2Δ%	2· Δ		2.
									3=	3· =		
										1· Δ *		
										50· +		
										<PF>		50.
									*	122·028522336 *		
										<PF>		122.028522336
F	4/5	OFF	Σ	GT	CAL	12	OFF	OFF	2+	2· +		2.
									3+	3· +		5.
									*	5· G +		
										<PF>	GT	5.
									3−	3· −	R GT	-3.
									4−	4· −	R GT	-7.
									5−	5· −	R GT	-12.

TAB	4/5	IC	Σ	GT	MOD	10/12	2TAX	2M	TOUCH	PRINT	DISPLAY
									*	12· Ḡ + R	
										<PF>	GT -12.
									GT ◇ *	7· Ḡ ◇ R	GT -7.
									GT ◇ *	7· Ḡ * R	
										<PF>	-7.
F	4/5	OFF	Σ	OFF	CAL	12	OFF	OFF	MI+	·······1·······	
										7· M̄ + R	MI -7.
									5		MI 5.
									MII+	·······2·······	
										5· M +	MII / MI 5.
									MI◇	·······1·······	
										7· M̄ ◇ R	MII / MI -7.
									MI*	·······1·······	
										7· M̄ * R	
										<PF>	MII -7.
									MII◇	·······2·······	
										5· M ◇	MII 5.
									MII*	·······2·······	
										5· M *	
										<PF>	5.
									#/P	5· ◇	5.
									2 #/P	#2	2.
									#/P	2· ◇	2.
									0÷	0· ÷	0.
									=	0· =	0.
										ERROR	
										0· *	E 0.
										<PF>	
									C	0· C	0.
										<PF>	0.
F	CUT	OFF	OFF	OFF	SET I	12	OFF	OFF		·······1·······	
										0· %	0.
										<PF>	0.
									3		3.
F	CUT	OFF	OFF	OFF	CAL	12	OFF	OFF		·······1·······	
										3· %	0.
										<PF>	0.
									C	0· C	0.
										<PF>	0.
F	CUT	OFF	OFF	OFF	SET I	12	OFF	OFF		·······1·······	
										3· %	
										<PF>	3.

TAB 4/5	IC	Σ	GT	MOD	10/12	2TAX	2M	TOUCH	PRINT		DISPLAY
F CUT	OFF	OFF	OFF	CAL	12	OFF	OFF				0.
F CUT	OFF	OFF	OFF	SET II	12	OFF	OFF		·······2·······		
									0·	%	
									<PF>		0.
								5			5.
F CUT	OFF	OFF	OFF	CAL	12	OFF	OFF		·······2·······		
									5·	%	
									<PF>		0.
F CUT	OFF	OFF	OFF	SET II	12	OFF	OFF		·······2·······		
									5·	%	5.
F CUT	OFF	OFF	OFF	CAL	12	OFF	OFF				0.
								1560			1,560.
								+TAX I	·······1·······		
									1,560·		
									46·8	Δ	
									1,606·8	*	
									<PF>		1,606.8
								1560			1,560.
								+TAX II	·······2·······		
									1,560·		
									78·	Δ	
									1,638·	*	
									<PF>		1,638.
								+TAX I	·······1·······		
									1,638·	◇	
									49·14	Δ	
									1,687·14	*	
									<PF>		1,687.14
								1560			1,560.
								×	1,560·	×	1,560.
								78900			78,900.
F 4/5	OFF	OFF	OFF	CAL	12	OFF	OFF	+TAX I	·······1·······		
									78,900·	=	
									123,084,000·	◇	
									3,692,520·	Δ	
									126,776,520·	*	
									<PF>		126,776,520.
								=			126,776,520.
								5			5.
								×	5·	×	5.
								+TAX I			5.
								=	5·	=	

KEY										TOUCH	PRINT		DISPLAY
TAB 4/5	IC	Σ	GT	MOD	10/12	2TAX	2M						
											25· *		25.
											\<PF\>		
										+TAX I	·······1·······		
											25· ◇		
											0·75 Δ		
											25·75 *		
											\<PF\>		25.75
										=			25.75
										C	0· C		
											\<PF\>		0.
2	CUT	OFF	OFF	OFF	CAL	12	OFF	OFF		1560			1,560.
										+	1,560·00 +		1,560.00
										1100			1,100.
										+	1,100·00 +		2,660.00
										+TAX II	·······2·······		
											2,660·00 ◇		
											133·00 Δ		
											2,793·00 *		
											\<PF\>		2,793.00
F	CUT	OFF	OFF	OFF	CAL	12	OFF	OFF		+TAX I	·······1·······		
											2,793·00 ◇		
											83·79 Δ		
											2,876·79 *		
											\<PF\>		2,876.79
										98000000 0000			980,000,000,000.
										+TAX I	·······1·······		
											980,000,000,000·		
											29,400,000,000· Δ		
											ERROR		
											1·00940000000 *		
											\<PF\>		E 1.00940000000
										C	0· C		
											\<PF\>		0.
										1560			1,560.
										+/−			−1,560.
										+TAX I	·······1·······		
											1,560· −	R	
											46·8 Δ̄	R R	
											1,606·8 − *	R	
											\<PF\>		−1,606.8
										1560			1,560.

KEY								TOUCH	PRINT		DISPLAY
TAB 4/5	IC	Σ	GT	MOD	10/12	2TAX	2M				
								−TAX I	·······1·······		
									1,560·		
									45·43689321 △̄	R	
									1,514·56310679 ∗		
									<PF>		1,514.56310679
								−TAX I	·······1·······		
									1,514·56310679 ◇		
									44·11348855 △̄	R	
									1,470·44961824 ∗		
									<PF>		1,470.44961824
								1560			1560.
								−TAX II	·······2·······		
									1,560·		
									74·28571429 △̄	R	
									1,485·71428571 ∗		
									<PF>		1,485.71428571
								−TAX II	·······2·······		
									1,485·71428571 ◇		
									70·74829932 △̄	R	
									1,414·96598639 ∗		
									<PF>		1,414.96598639
F	CUT	OFF	OFF	OFF	SET I	12	OFF	OFF	·······1·······		
									3· %		
									<PF>		3.
								C			0.
F	CUT	OFF	OFF	OFF	CAL	12	OFF	OFF	·······1·······		
									0· %		
									<PF>		0.
F	CUT	OFF	OFF	OFF	SET I	12	OFF	OFF	·······1·······		
									0· %		
									<PF>		0.
								1234			1234.
F	CUT	OFF	OFF	OFF	CAL	12	OFF	OFF	·······1·······		
									1,234· %		
									<PF>		0.
F	CUT	OFF	OFF	OFF	SET II	12	OFF	OFF	·······2·······		
									5· %		
									<PF>		5.
								C			0.
F	CUT	OFF	OFF	OFF	CAL	12	OFF	OFF	·······2·······		
									0· %		
									<PF>		0.

KEY									TOUCH	PRINT			DISPLAY
TAB 4/5	IC	Σ	GT	MOD	10/12	2TAX	2M						
									98000000				
									0000				980,000,000,000.
									+TAX I	·······1·······			
F CUT OFF	OFF	OFF		CAL	12	OFF	OFF			980,000,000,000·			
										ERROR			
										0·	*		
										<PF>			E 0.
									C	0·	C		
										<PF>			0.
									2				2.
									×	2·	×		2.
									3				3.
									×	3·	×		6.
									EXC	3·	↕		3.
									×	6·	×		18.
									EXC	6·	↕		6.
									×	18·	×		108.
									EXC	18·	↕		18.
									×	108·	×		1,944.
									=	108·	=		
										209,952·	*		
										<PF>			209,952.
									9				9.
									√	9·	R		
										3·	*		
										<PF>			3.
									√	3·	R		
										1·73205080756	*		
										<PF>			1,73205080756
									+/-				-1,73205080756
									√	1·73205080756	R	R	
										ERROR			
										1·31607401294	– *	R	
										<PF>			E -1,31607401294
									C	0·	C		
										<PF>			0.
A CUT OFF	OFF	OFF		CAL	12	OFF	OFF		123				123.
									+	1·23	+		1.23
									456				456.
									+	4·56	+		5.79
									◇	5·79	◇		5.79
									*	5·79	*		

TAB 4/5	IC	Σ	GT	MOD	10/12	2TAX	2M	TOUCH	PRINT	DISPLAY
									<PF>	5.79
AII CUT	OFF	OFF	OFF	CAL	12	OFF	OFF	789		789.
								×	789· ×	789.
								100		100.
								=	1·00 =	
									789·00 *	
									<PF>	789.00
(Don't do it.)								123		123.
								+	123·00 +	123.00
								456		456.
								+	456·00 +	579.00
								*	579·00 *	
									<PF>	579.00
F	4/5	OFF	OFF	OFF	CAL	12	ON	ON	(RESET)	<PF>	
									C	
									<PF>	0.
								7		7.
								+/-		-7.
								MI+	7· M̄ + R MI	-7.
								5	MI	5.
								MII+	MI	5.
								MI◇	7· M̄ ◇ R MI	-7.
								MI*	7· M̄ * R	
									<PF>	-7.
F	4/5	OFF	OFF	OFF	SETI	12	ON	ON		0· %	
									<PF>	0.
								3		3.
F	4/5	OFF	OFF	OFF	CAL	12	ON	ON		3· %	
									<PF>	0.
								C	0· C	
									<PF>	0.
F	4/5	OFF	OFF	OFF	SETI	12	ON	ON		3· %	
									<PF>	3.
F	4/5	OFF	OFF	OFF	CAL	12	ON	ON			0.
F	4/5	OFF	OFF	OFF	SETII	12	ON	ON			0.
								5		5.
F	4/5	OFF	OFF	OFF	CAL	12	ON	ON			5.
F	4/5	OFF	OFF	OFF	SETII	12	ON	ON			5.
F	4/5	OFF	OFF	OFF	CAL	12	ON	ON			5.
								CE		0.

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

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage 1	V_{DD}	$-0.3 \sim 6$	V
Supply Voltage (LCD Drive)	V_{LC}	$-0.3 \sim V_{DD} + 0.3$	V
Input Voltage	V_{IN}	$-0.3 \sim V_{DD} + 0.3$	V
Output Voltage	V_{OUT}	$-0.3 \sim V_{DD} + 0.3$	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}	$-55 \sim 125$	°C
Operating Temperature	T_{opr}	$0 \sim 40$	°C

ELECTRICAL CHARACTERISTICS

Recommended operating conditions ($V_{SS} = 0V$, $T_{opr} = 0 \sim 40°C$)

PARAMETER	SYMBOL	TEST CIRCUIT	CONDITION		MIN	MAX	UNIT
Operating Temperature	T_{opr}	—	—		0	40	°C
Supply Voltage	V_{DD}	—	NORMAL		4.5	5.5	
		—	SLOW				
		—	HOLD		2.0		
High-Level Input Voltage (Non-Schmitt Circuit)	V_{IH1}	—	$V_{DD} \geqq 4.5V$		$V_{DD} \times 0.7$	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}	—	$V_{DD} \geqq 4.5V$		0	$V_{DD} \times 0.3$	
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 ($V_{SS} = 0V$, $T_{opr} = 0 \sim 40°C$)

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, $\overline{RESET}$, $\overline{HOLD}$	$V_{DD} = 5.5V$ $V_{IN} = 5.5 / 0V$	—	—	± 2	μA
	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}	—	$\overline{RESET}$, $\overline{HOLD}$		100	220	450	
Output Leakage Current	I_{LO1}	—	Sink Open Drain R port	$V_{DD} = 5.5V$ $V_{OUT} = 5.5V$	—	—	2	μA
	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	$V_{DD} = 5.5V$ $I_{OH} = -1.6mA$	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		—	—	35	$k\Omega$
	R_{OC}	—	COM					
Output Voltage	$V_{O2/3}$		SEG / COM	$V_{DD} = 5V$ $V_{DD} - V_{LC} = 3V$	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}	—	—	$V_{DD} = 5.5V$, $V_{LC} = V_{SS}$ $f_c = 4MHz$	—	3	6	mA
Supply Current (Hold)	I_{DDH}	—	—	$V_{DD} = 5.5V$	—	0.5	10	μA

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

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

| 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

AC electrical characteristics ($V_{SS} = 0V$, $V_{DD} = 4.5 \sim 6.0V$, $T_{opr} = 0 \sim 40°C$)

PARAMETER	SYMBOL	TEST CIR-CUIT	CONDITION	MIN	TYP.	MAX	UNIT
Instruction Cycle Time	t_{CY}	—	NORMAL	1.9	—	20	μs
		—	SLOW	235	—	267	
High-Level Clock Pulse Width	t_{WCH}	—	External Clock Operation	80	—	—	ns
Low-Level Clock Pulse Width	t_{WCL}	—					
Shift Data Hold Time	t_{SDH}	—	—	0.5tcy −300	—	—	ns
High Speed Timer / Counter Input Frequency	f_{HT}	—	—	—	—	f_c	MHz

WAVEFORMS FOR DISPLAY
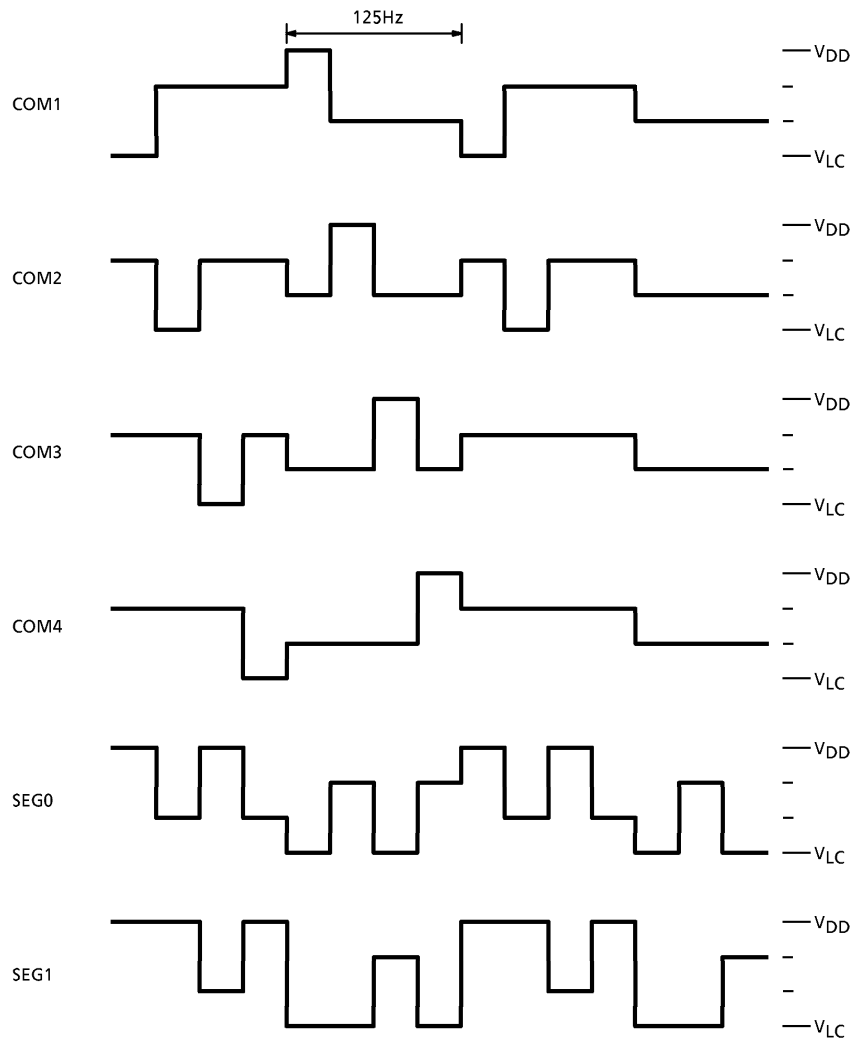
THE PROPOSAL OF OUTER CIRCUIT FOR TAX RATE HOLDING WITH BACK-UP BATTERY.
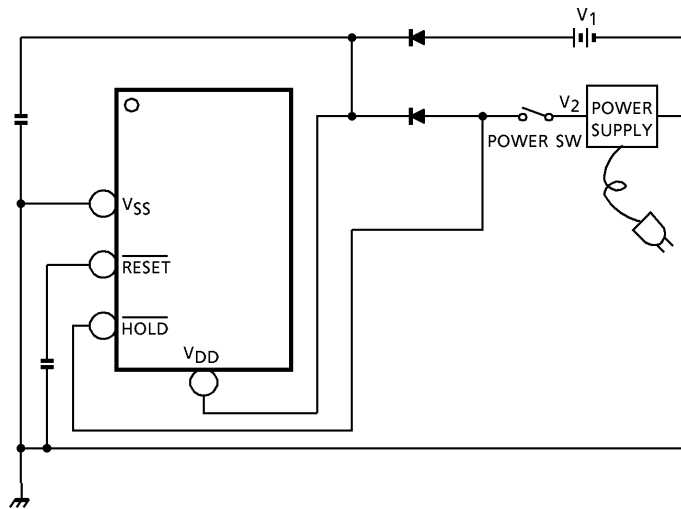
(Note)
$V_1 = +3V$: battery supply
$V_2 = +5V$: DC supply

$\left(\begin{array}{l} \overline{\text{HOLD}} \text{ pin is pulled down in the LSI, but normally pulled up to } V_{DD}. \\ \overline{\text{RESET}} \text{ pin is pulled up to } V_{DD}. \end{array} \right)$
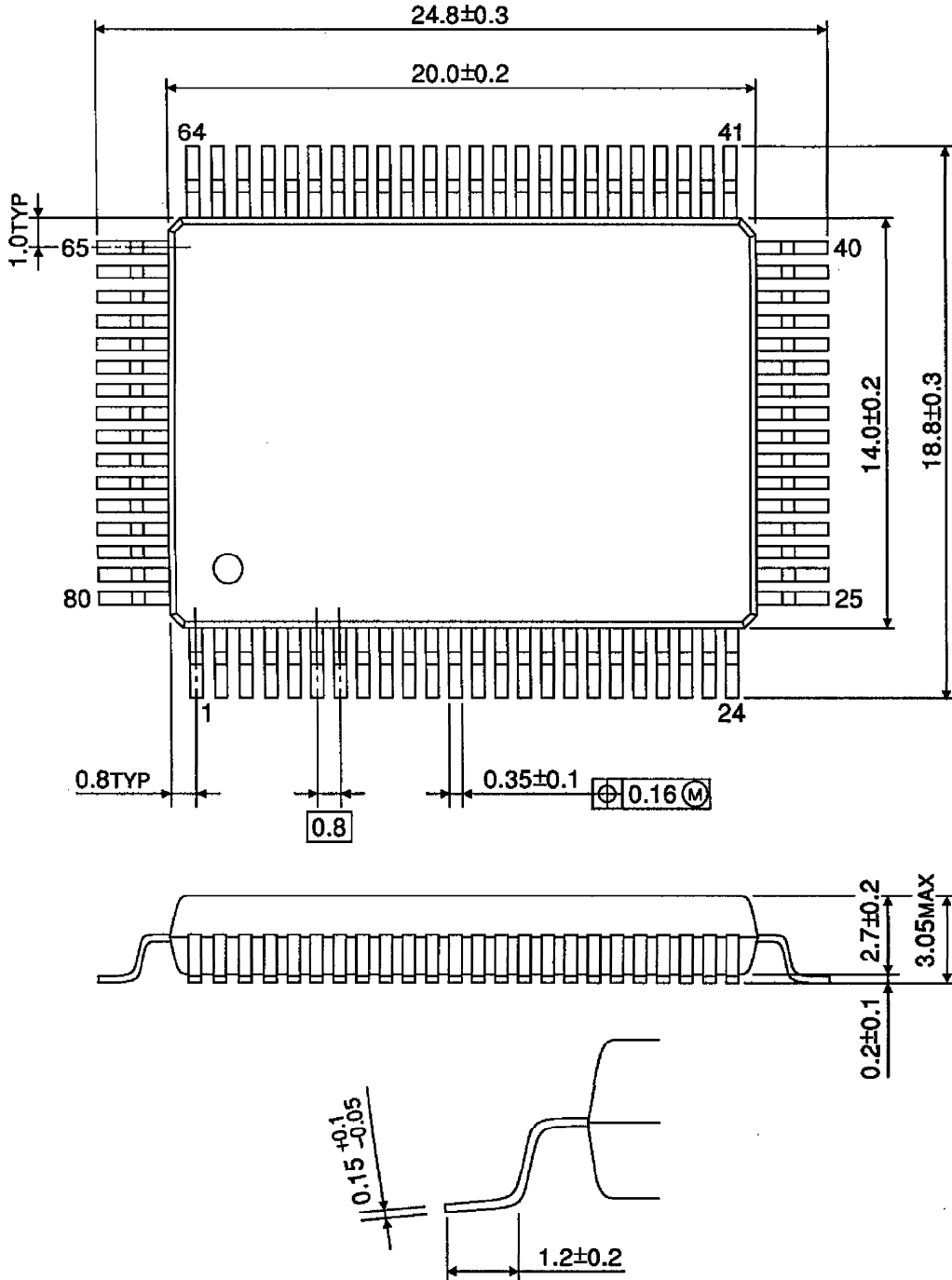
① Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to $\overline{\text{HOLD}}$ pin.
Then calculator operates normally.

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)

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 : 1.52g (Typ.)