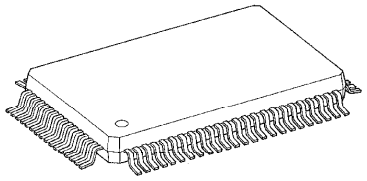
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



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

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

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- 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

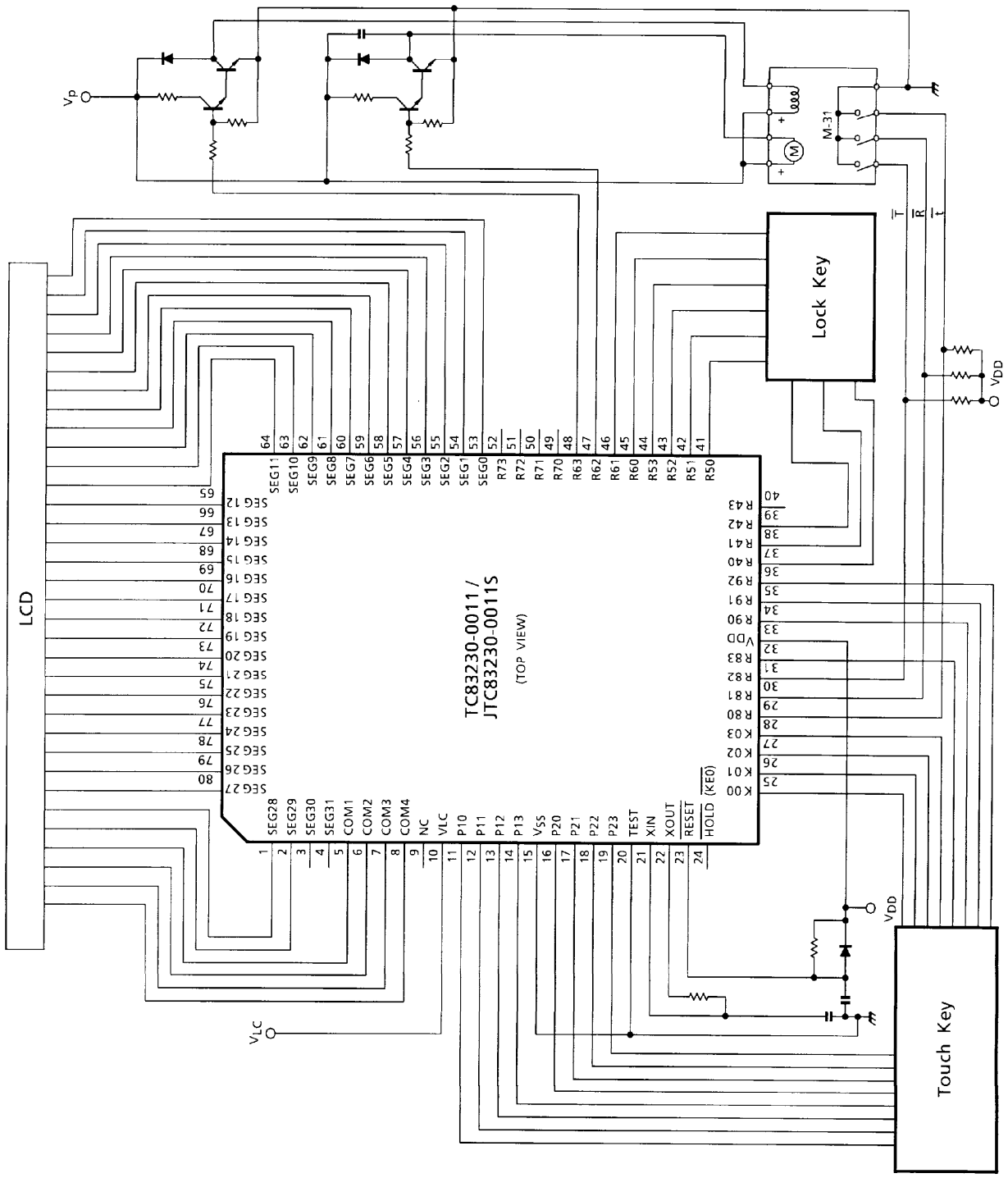
Protection

i) In the overflow condition, all key except "C", "C / CE", "CE", "Feed", "→" key are inoperative.

ii) Key chatter protection (at f = 4 MHz)

Auto-clear at power on

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

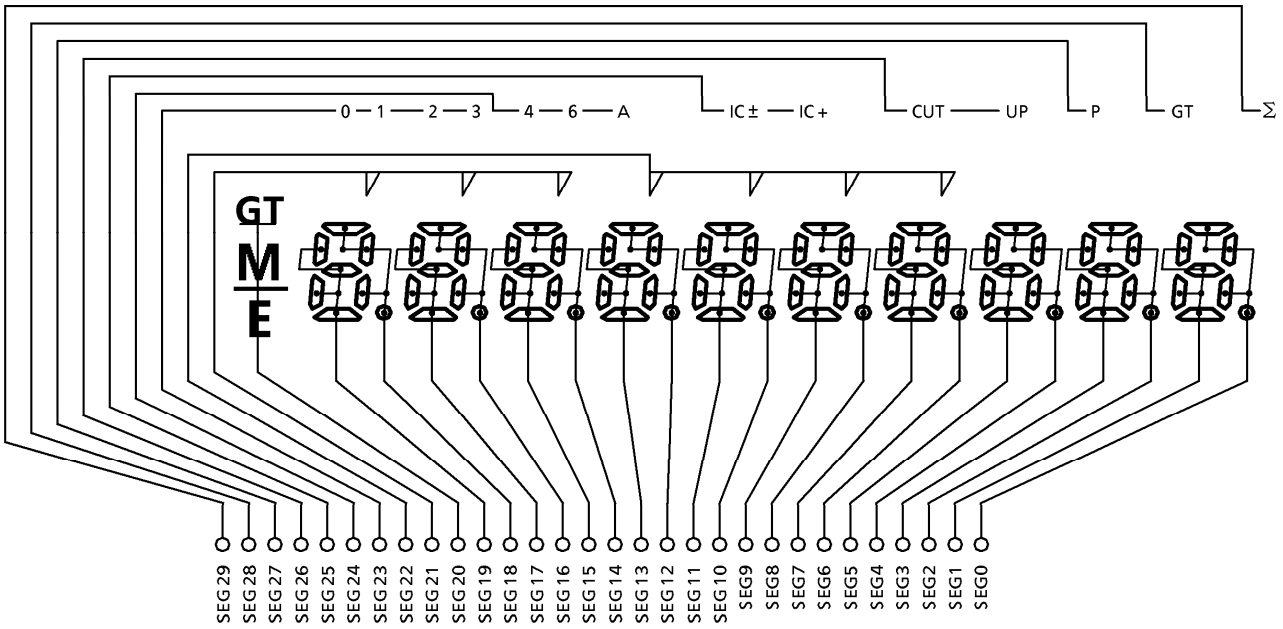


SYSTEM BLOCK DIAGRAM

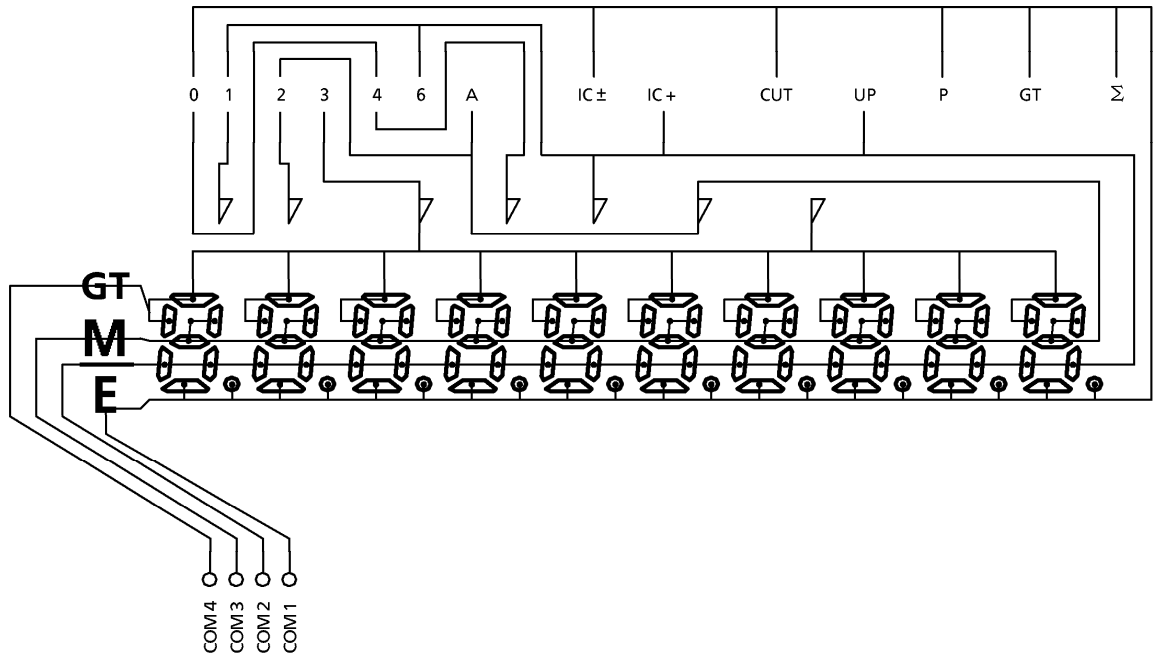
TC83230-0011, JTC83230-0011S—03

CONNECTION OF LCD

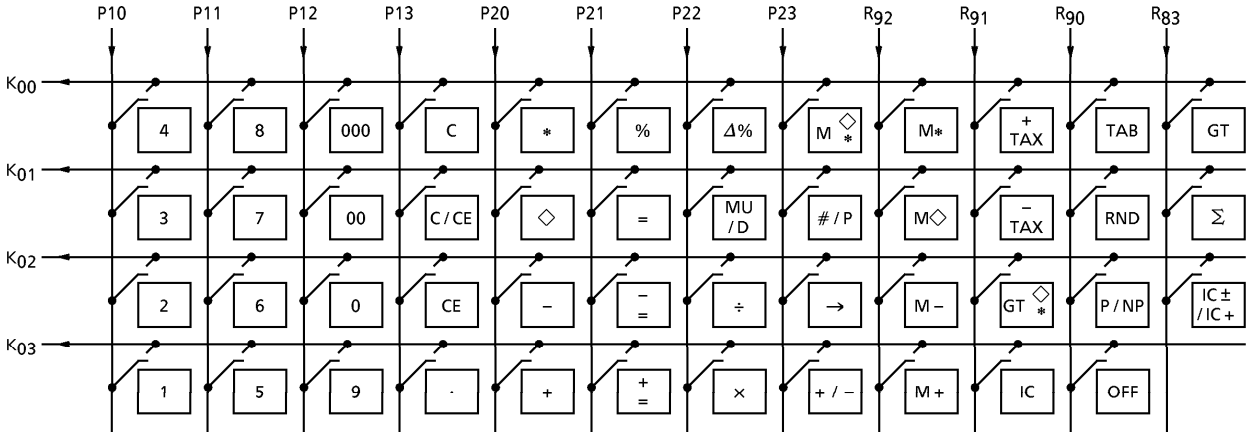
SEGMENT



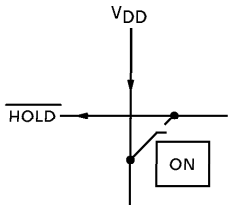
COMMON

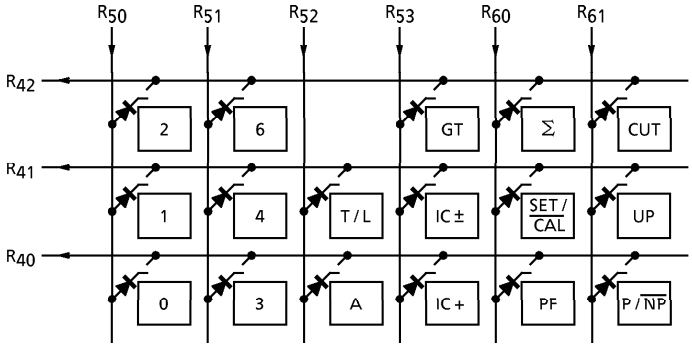


KEY CONNECTION



Touch Key

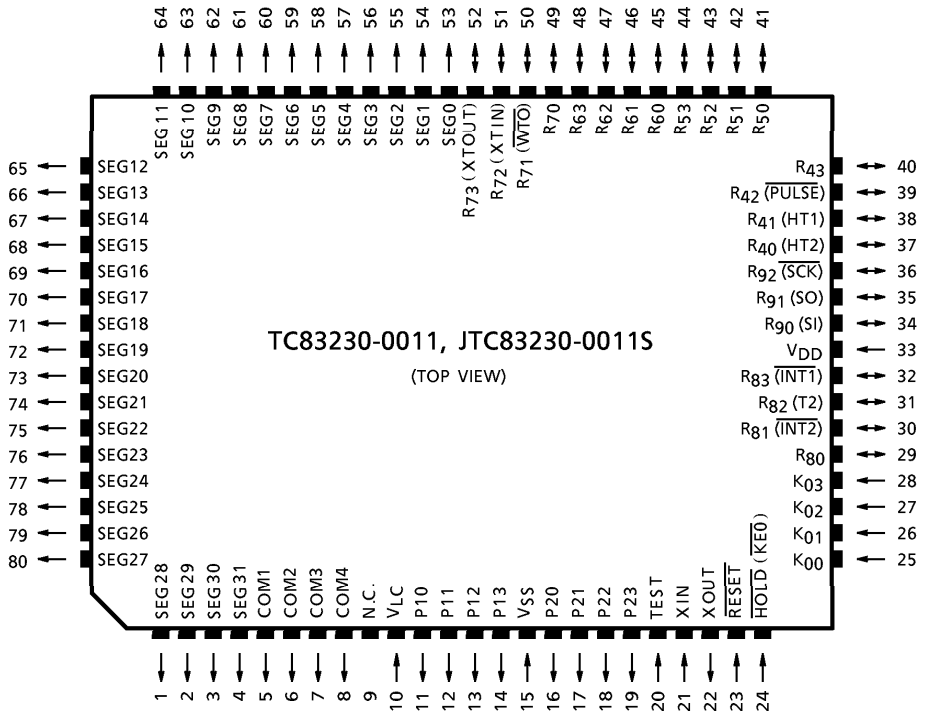




Lock Key

PIN ASSIGNMENT

QFP80



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
*, ◇	Operates as total or sub-total key	Unused
+, − ×, ÷	Operates as four-function key	Unused
=	Operates as = key	Unused
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
Δ%	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
→	Operates as right-shift key	Operates as right-shift key
+ / −	Operates as sign change key	Unused
M+, M− M*, M◇ M*◇	Operates as memory function key	Unused
+TAX	Operates as +tax key	Unused
−TAX	Operates as −tax key	Unused
+/=	Operates as +/= key	Unused
−/=	Operates as −/= key	Unused
Σ	Operates as Σ key	Unused
IC± / IC+	Operates as IC± / 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] [00, 000] ..... Keys in numbers from 0 to 9, 00, and 000. If the number of display digits exceeds 10 key entry is invalid.

[·] ..... If this key is pressed after a key operation except data entry, the display 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, display does not change.

[+, −] ..... Add or subtract operation data and display 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 display 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

$a \times b\%$ + ……a + $(ab / 100)$
$c\%$ + ……a + $(ac / 100)$
$a \times b\%$ − ……a − $(ab / 100)$
$c\%$ − ……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+, M−] .... If the arithmetic instruction is not stored or if the mode is constant calculation mode, first prints the display 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.

$\begin{bmatrix} + & - \\ =, & = \end{bmatrix}$ ..... If the mode is manage of addition or substruction operation, operation is the same as that for + or − key. And when GT mode is specified, the result of addition / substruction 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 :

aMU / Db = ·····		a / (1 – (b / 100)) – a (Prints profit)
	a / (1 – (b / 100))	(Mark-up)
c = ·····		a / (1 – (c / 100)) – a (Prints profit)
	a / (1 – (c / 100))	(Mark-up)
aMU / Db + / – = ·····		a / (1 + (b / 100)) – a (Prints profit)
	a / (1 + (b / 100))	(Mark-down)
c + / – = ·····		a / (1 + (c / 100)) – a (Prints profit)
	a / (1 + (c / 100))	(Mark-down)

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

Δ% key operation example :

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)

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

[→] ..... Shifts the contents of the display 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$^{\diamond}_{*}$] ..... 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 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 display 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/$\overline{L}$] 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/$\overline{L}$] 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 / $\overline{L}$] 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 / $\overline{NP}$] ..... 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.

[T / $\overline{L}$] ..... When the [T / $\overline{L}$] lock key is on, the [P / NP] , [RND] , and [TAB] keys are valid. When the [T / $\overline{L}$] key is off, the [NP] , [CUT] , [UP] , and [0, 1, 2, 3, 4, 6, A] lock keys are valid.

[SET / $\overline{CAL}$] ..... When the (SET / $\overline{CAL}$) lock key is on, prints and express the stored tax rate. When the (SET / $\overline{CAL}$) 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						TOUCH	PRINT		DISPLAY
TAB	4/5	IC	Σ	GT	MOD				
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.
		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. %		
							66.66666666 *		
							<PF>		66.66666666
						2 MU/D	2. M		2.
						3=	3. %		
							=		
							0.06185567 *		
							2.06185567 *		
							<PF>		2.06185567
						2Δ%	2. -		2.

(Note) <PF> ... Paper feed

KEY						PRINT		DISPLAY
TAB	4/5	IC	Σ	GT	MOD	TOUCH			
						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.

KEY						PRINT		DISPLAY	
TAB	4/5	IC	Σ	GT	MOD	TOUCH			
						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 *		

KEY							TOUCH	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.
							×	1560. ×		1,560.
							78900			78,900.
							+TAX	78900. =		
								123084000. ◇		
								%		
								3692520. ◇		
								126776520. *		
								<PF>		126,776,520.
							=			126,776,520.
							5			5.
							×	5. ×		5.
F	CUT	OFF		OFF	OFF	CAL	+TAX			5.
							=	5. =		
								25. *		
								<PF>		25.
							+TAX	25. ◇		
								%		
								0.75 ◇		
								25.75 *		
								<PF>		25.75
							=			25.75
							C	0. C		
								<PF>		0.
2							1560			1,560.
							+	1560.00 +		1,560.00
							1100			1,100.
							+	1100.00 +		2,660.00
							+TAX	2660.00 ◇		
								%		
								79.80 ◇		
								2739.80 *		
								<PF>		2,739.80
F							+TAX	2739.80 ◇		
								%		
								82.194 ◇		
								2821.994 *		
								<PF>		2,821.994

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.

MAXIMUM RATINGS (V_{SS} = 0 V)

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} = 0 V, T_{opr} = 0~40°C)

PARAMETER	SYMBOL	TEST CIR-CUIT	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}	—	$V_{DD} \geqq 4.5$ V	V_{DD} × 0.7	V_{DD}	
High-Level Input Voltage (Schmitt Circuit)	V_{IH2}			V_{DD} × 0.75	V_{DD}	
High-Level Input Voltage	V_{IH3}	—	$V_{DD} < 4.5$ V	V_{DD} × 0.9	V_{DD}	
Low-Level Input Voltage (Non-Schmitt Circuit)	V_{IL1}	—	$V_{DD} \geqq 4.5$ V	0	V_{DD} × 0.3	
Low-Level Input Voltage (Schmitt Circuit)	V_{IL2}			0	V_{DD} × 0.25	
Low-Level Input Voltage	V_{IL3}	—	$V_{DD} < 4.5$ V	0	V_{DD} × 0.1	

DC electrical characteristics (V_{SS} = 0 V, T_{opr} = 0~40°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} = 5.5 V V_{IN} = 5.5 / 0 V	—	—	±2	μA
	I_{IN2}	—	Open Drain R port, P port					
Input Resistance	R_{IN1}	—	KO port TEST with Input Resistor	V_{DD} = 5.5 V V_{IN} = 5.5 / 0 V	30	70	150	kΩ
	R_{IN2}	—	$\overline{RESET}$, $\overline{HOLD}$		100	220	450	
Output Leakage Current	I_{LO1}	—	Sink Open Drain R port	V_{DD} = 5.5 V V_{OUT} = 5.5 V	—	—	2	μA
	I_{LO2}	—	Source Open Drain R port, P port	V_{DD} = 5.5 V V_{OUT} = −1.5 V	—	—	−2	
High-Level Output Voltage	V_{OH}	—	Source Open Drain R port, P port	V_{DD} = 5.5 V I_{OH} = −1.6 mA	2.4	—	—	V
Low-Level Output Voltage	V_{OL}	—	Sink Open Drain R port	V_{DD} = 5.5 V I_{OL} = 1.6 mA	—	—	0.4	V
Pull-Down Resistance	R_{OUT}	—	R port, P port	V_{DD} = 5.5 V V_{IN} = 5.5 V	30	70	150	kΩ
Output Resistance	R_{OS}	—	SEG	V_{DD} = 5 V $V_{DD} - V_{LC}$ = 3 V	—	—	35	kΩ
	R_{OC}	—	COM					
Output Voltage	$V_{O2/3}$	—	SEG / COM		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 V, V_{LC} = V_{SS} f_c = 4 MHz	—	3	6	mA
Supply Current (Hold)	I_{DDH}	—	—	V_{DD} = 5.5 V	—	0.5	10	μA

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

(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.

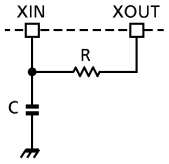
(Note 4) $V_{O2/3}$: Shows 2 / 3 Level Output Voltage at which 1 / 4 or 1 / 3 duty LCD drive.

(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} = 5.3 V / 0.2 V should be under that KO port is open and R port Voltage Level is valid.

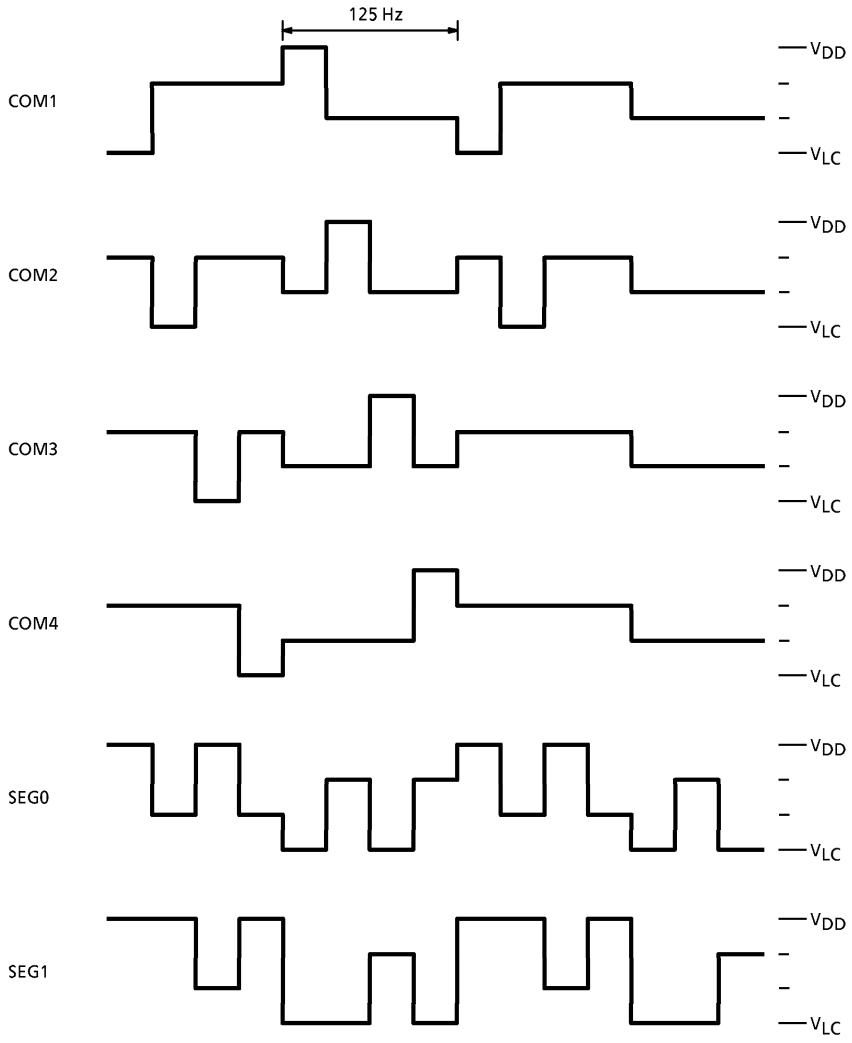
OSCILLATION CIRCUIT (V_{SS} = 0 V, V_{DD} = 4.5~5.5 V, T_{opr} = 0~40°C)

RECOMMENDED CIRCUIT	CONDITION	MIN	TYP.	MAX	UNIT
	V_{DD} = 5.0 V C = 100 pF R = 1 kΩ ± 2%	2.4	4.0	5.6	MHz

AC electrical characteristics (V_{SS} = 0 V, V_{DD} = 4.5~6.0 V, T_{opr} = 0~40°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}	—	—	0.5 tcy − 300	—	—	ns
High Speed Timer / Counter Input Frequency	f_{HT}	—	—	—	—	f_C	MHz

WAVEFORMS FOR DISPLAY



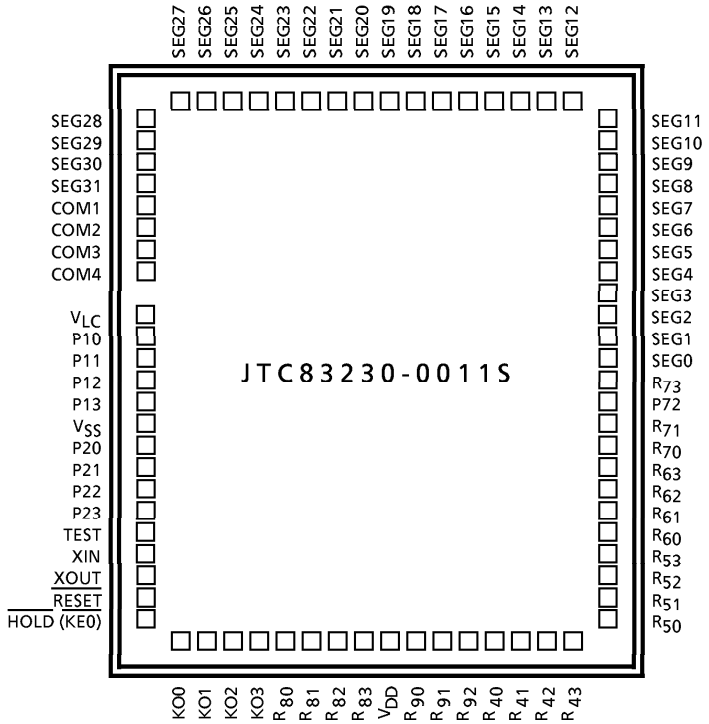
PAD LOCATION TABLE

(μm)

NAME	X POIN	Y POINT
KO0	– 1282	– 2074
KO1	– 1122	– 2074
KO2	– 962	– 2074
KO3	– 802	– 2074
R_{80}	– 641	– 2074
R_{81}	– 438	– 2074
R_{82}	– 278	– 2074
R_{83}	– 74	– 2074
V_{DD}	86	– 2074
R_{90}	246	– 2074
R_{91}	449	– 2074
R_{92}	610	– 2074
R_{40}	802	– 2074
R_{41}	962	– 2074
R_{42}	1122	– 2074
R_{43}	1282	– 2074
R_{50}	1644	– 2011
R_{51}	1644	– 1807
R_{52}	1644	– 1647
R_{53}	1644	– 1444
R_{60}	1644	– 1283
R_{61}	1644	– 1080
R_{62}	1644	– 920
R_{63}	1644	– 716
R_{70}	1644	– 556
R_{71}	1644	– 353
R_{72}	1644	– 193
R_{73}	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_{LC}	– 1644	520
P10	– 1644	359
P11	– 1644	156
P12	– 1644	– 4
P13	– 1644	– 208
V_{SS}	– 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

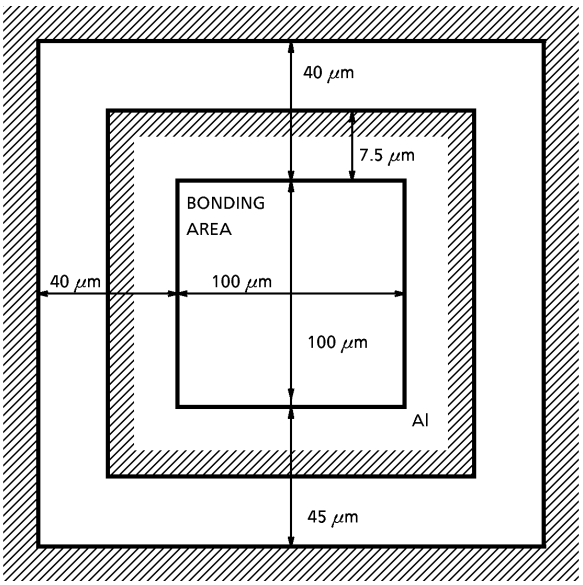
CHIP LAYOUT



Chip size : 3.78 × 4.67 (mm)
Chip thickness : 450 ± 30 (μm)
Substrate : V_{SS}
Pad size : 100 (μm□)

PAD LAYOUT

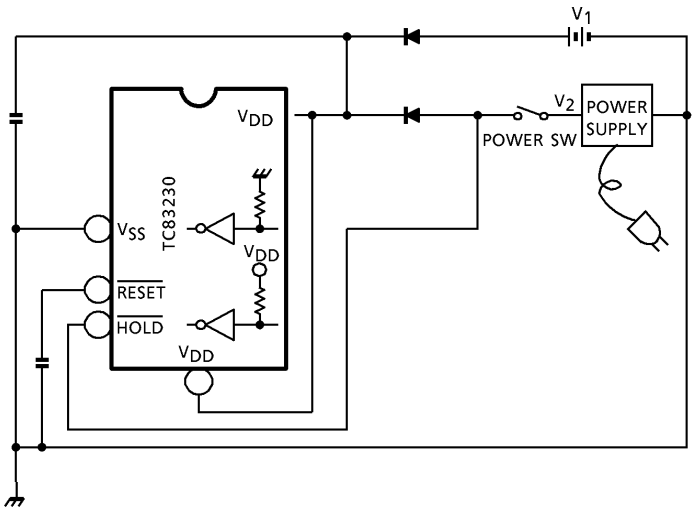
ACTIVE ELEMENT



SCRIBE LINE

Pad pitch 160 (μm)

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



(Note)
V_1 = +3 V : battery supply
V_2 = +5 V : DC supply

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

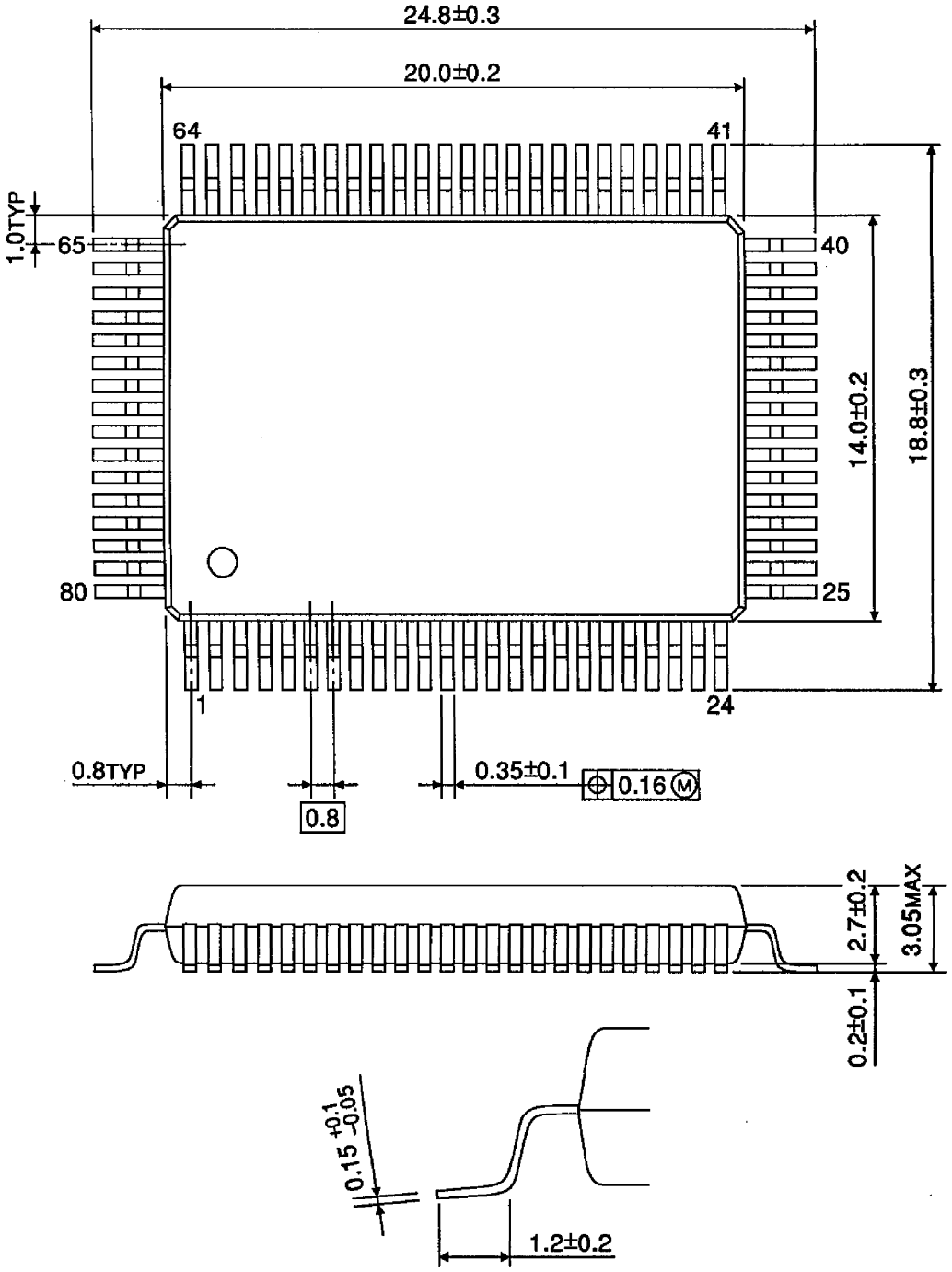
③ Setting POWER SW to ON, V_2 is supplied to V_{DD} pin, and also to $\overline{HOLD}$ pin.
Then calculator operates normally with TAX RATE to be held.

<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.

PACKAGE DIMENSIONS

QFP80-P-1420-0.80A Unit : mm



Weight : 1.52 g (Typ.)

General Specification for Bare Calculator LSI Chip

1. Purpose

This is to specify the quality standard for integrated circuits produced by TOSHIBA CORPORATION (hereinafter referred to as VENDOR) which are to be delivered to PURCHASER.

2. Definition

This specification applies only to the bare calculator LSI chips produced by VENDOR and purchased by PURCHASER and defines the general specification items.

3. Priority of specifications

When there are discrepancies in or questions arising from the specifications and instructions provided by VENDOR, the following documents shall apply, in the priority order shown.

1) Individual specifications for the bare calculator LSI chip
(both PURCHASER and VENDOR should refer to the technical data sheet for the relevant product.)
2) General specifications for the bare calculator LSI chip
3) Other related specifications and standards

4. Characteristics

To be shown in the individual specification sheets.
The individual specifications shall consist of the following four items.

1) Rating specifications
2) Electrical characteristics
3) Pin configuration and mechanical dimensions
4) Others

5. Inspection of product for delivery

5.1 Inspection lot

a) The inspection lot shall consist of products produced using the same material, working from the same design, via the same production process, using the same facilities, with the same assured quality and using the same quality assurance method; the lot number shall be put on all trays to allow tracing of the lot history.

b) The products in an inspection lot number should all be taken from the same VENDOR's lot number.

5.2 Sampling plan

Statistical sampling and inspection shall be in accordance with MIL-STD-105D single sampling plans for normal inspections, general inspection level Ⅱ.

The acceptable quality level (AQL) shall be as specified in the following table:

TEST	AQL (%)
Electrical	2.5
Visual	4.0

5.3 Electrical criteria

Criteria for electrical characteristics are prescribed in Attachment-1.

5.4 Visual criteria

Visual criteria are prescribed in Attachment-2.

6. Incoming inspection

6.1 General

a) PURCHASER's incoming inspection should be done within 15 days of PURCHASER receiving the products.

b) PURCHASER shall report the results of incoming inspection to VENDOR and provide VENDOR with detailed data of failure rate, quoting VENDOR's lot number for failed products, if VENDOR demands a report from PURCHASER.

6.2 Inspection procedure

PURCHASER should perform his incoming inspection according to the following procedure.

a) First: Visual inspection should be carried out

b) Second: Electrical and other inspections should be carried out before PURCHASER's manufacturing process is started.

7. Treatment for defective lots and products

Defective lots and defective products which are found in PURCHASER's incoming inspection can be returned to VENDOR with detailed description of failures.
However, if VENDOR does not receive the defective items within 30 days of PURCHASER's incoming inspection, VENDOR is absolved of responsibility for defects.

8. Packing and labeling

a) Dies shall be placed in die tray in order with the top metal surface facing up.

b) A pile consists of five trays and several piles are packed in a package. These piles and packages have printed labels on them as shown below.

Date	
Name	
Lot No.	
Net	
TOSHIBA MADE IN JAPAN	

c) PURCHASER shall return these packing materials to VENDOR at VENDOR's request.

9. Storage criteria

Solid state chips, unlike packaged devices, are non-hermetic devices and are normally fragile and small in size. They therefore, require special handling considerations as follows:

9.1 Chips must be stored under proper conditions to ensure that they are not subjected to a moist and/or contaminated atmosphere that will alter their electrical, physical or mechanical characteristics.
After the shipping container is opened, the chips must be stored under the following conditions:

A. Storage temperature: 40°C max
B. Relative humidity: 50% max
C. Clean, dust-free environment

9.2 The user must exercise proper care when handling chips or wafers so as to prevent even the slightest physical damage to the chip.

9.3 During chip-mounting and leads bonding the user must use proper assembly techniques to obtain proper electrical, thermal and mechanical performance.

9.4 After the chip has been mounted and the leads bonded, all necessary procedures must be followed by the user to ensure that these non-hermetic chips are not subjected to a moist or contaminated atmosphere which might cause the development of electrical conductive paths across the relatively small insulating surfaces.
In addition, proper consideration must be given to the protection of these devices from other harmful environmental factors which could conceivably adversely affect their proper performance.

10. Handling criteria

The user should find the following suggested precautions helpful when handling chips.
In any event, because of the extremely small size and the fragile nature of chips, care should be taken when handling these devices.

10.1 Grounding

a) Bonders, pellet pick-up tools, table tops, trimming and forming tools, sealing equipment and any other equipment used in chip handling should be properly grounded.

b) The operator should be properly grounded.

10.2 In-process handling

a) Assemblies or sub-assemblies of chips should be transported and stored in conductive carriers.

b) All external leads on the assemblies or sub-assemblies should be shorted together.

11. Visual Inspection Criteria

11.1 Visual inspection magnification shall be 40×

11.2 Defects defined:

11.2.1 Thickness

See individual specifications in the technical data sheets.

11.2.2 Chips and cracks

A die shall be rejected if:

Any crack or chip extends for more than a length of 35 μm inside the scribe line (see Figure 1).

11.2.3 Metallization

A die shall be rejected if:

a) more than 25% of the metallization of any bonding pad is missing.

b) there is a short or break which affects electrical characteristics in any lead pattern (see Figure 2).

11.2.4 Glass protection coat

A die shall be rejected if:

The glass protection coat covers more than 25% of any bonding pad.

11.2.5 Attached foreign material

A die shall be rejected if:

a) a die is covered by stains or attached foreign material the area of which is greater than five times the bonding pad area.

b) it exhibits residual ink, stains or attached foreign material which cover more than 20% of any active bonding pad (see Figure 3).

11.2.6 Others

A die shall be rejected if:

a) there are no probe needle scratches on any of the bonding pads.

b) if it has been marked with ink.

11.3 Parameter limits for samples should be applied as necessary

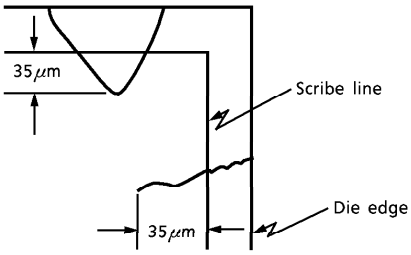


Figure 1

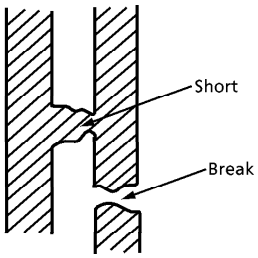


Figure 2 Lead pattern

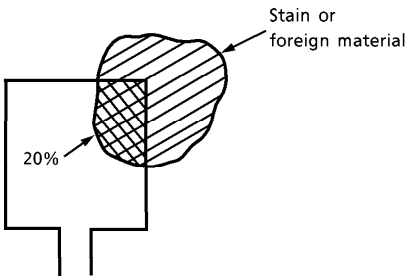
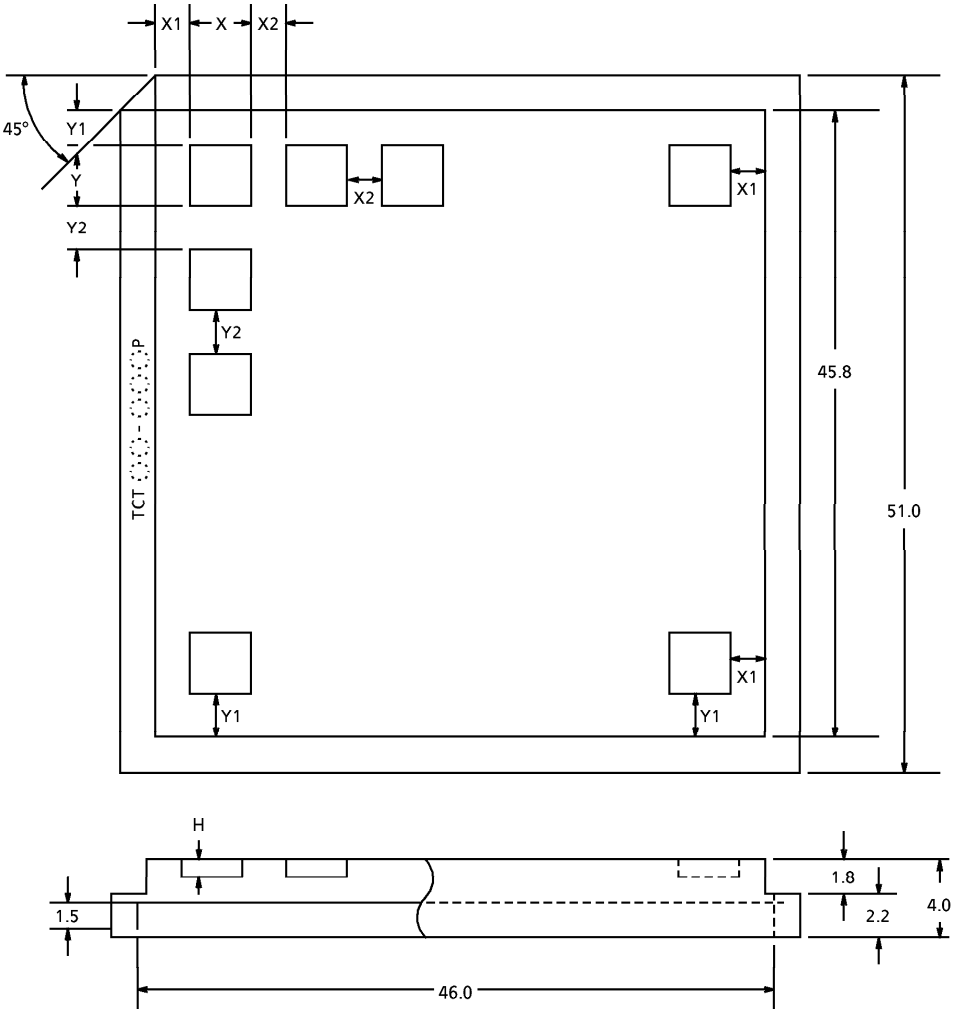


Figure 3

External Dimensions of Chip Tray



Please select a tray name from the table according to the chip size:

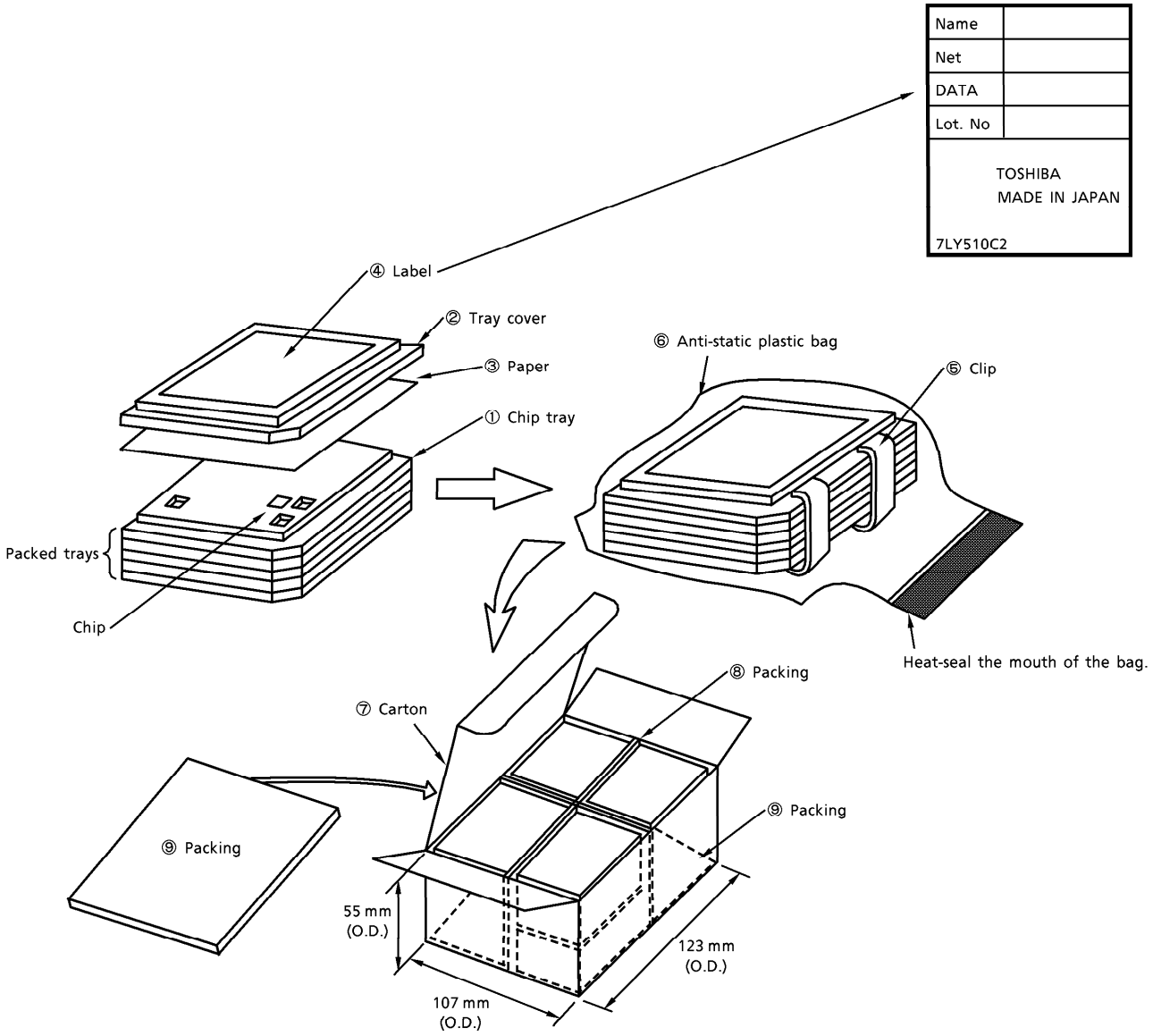
Unit: mm

Tray name	X	Y	H	No. of pockets (pcs)	X1	X2	Y1	Y2
TCT28-060P	2.80	2.80	0.60	10×10 (100)	1.700	1.800	1.700	1.600
TCT33-060P	3.30	3.30	0.60	10×10 (100)	1.900	1.000	1.900	1.000
TCT38-060P	3.80	3.80	0.60	10×10 (100)	1.200	0.600	1.200	0.600
TCT45-060P	4.50	4.50	0.60	7×7 (49)	2.050	1.700	2.050	1.700
TCT53-060P	5.30	5.30	0.60	7×7 (49)	1.350	1.000	1.350	1.000

Tray material:

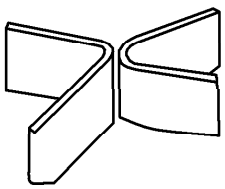
Carbon-bearing polypropylene

Packing Method 1



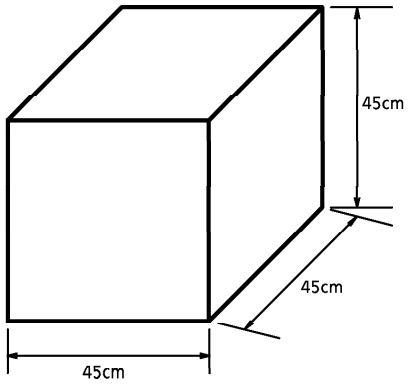
Place eight bags of chip trays in each carton ⑦. Lay one sheet of packing (7UF44F) ⑨ on top before closing the lid of the carton (see the diagram above).

Prepare the packing ⑧ by cutting a sheet of 7UF44F into halves and folding each half in half as shown below; use these halves as inner partitions.



Packing Method 2

Shipping box



- Inner box : Containing 20 boxes
- Weight : Approx. 15 kg (including packing material)
- Material : Corrugated cardboard
- IC contents : 36 × 5 × 8 × 20 = 28.800 pcs