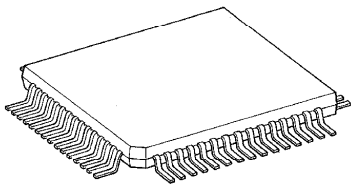
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T7987A, JT7987AY-CS

T7987A, JT7987AY-CS CMOS 1 CHIP LSI FOR LCD ELECTRONIC CALCULATOR

The T7987A, JT7987AY-CS is a 1 chip microcomputer for 10-digits + 2-digits electronic scientific calculation. T7987A, JT7987AY-CS is the complete single chip CMOS LSI for electronic calculator with 10 digit, 67 function, 3 expression and hexadecimal, octal and binary, statistic calculation, fractional number calculation, and logic operation with the following features.



LQFP60-P-1414-0.80

Weight : 0.66g (Typ.)

FEATURES

- Display 12 display digits plus 2 digits code at the right margin.
  - Scientific and engineering display.

    Mantissa 10 digits plus exponent 2 digits plus negative code 2 digits.
  - Other than above

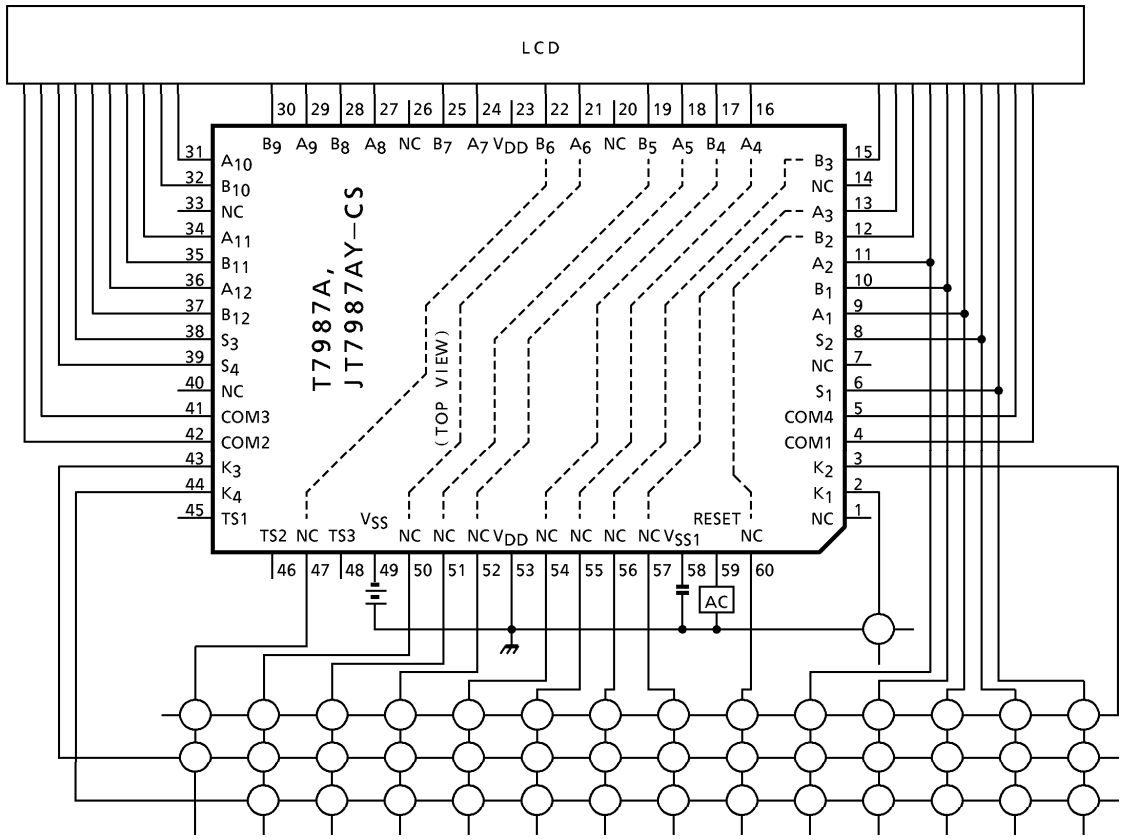
    Mantissa 10 digits plus negative code 1 digit.
- 13 kinds of special display

M	Memory	HEX	Hexadecimal mode
–	Mantissa and exponent Minus	SD	Statistic calculation mode
E	Error	DEG	Degree
INV	Inverse	RAD	Radian
HYP	Hyperbolic	GRAD	Gradian
BIN	Binary mode	( )	Parenthesis calculation
OCT	Octal mode		

- The minus sign of the mantissa is floating minus.
- The arithmetic key operation in clouding Y^X or $\sqrt[X]{Y}$ has same sequence as mathematical equation. 6 pending operations are allowed and ( ) are up to continuous 15 levels.
- Fractional number calculation.
- Statistic calculation includes 3 kinds of the normal distribution, total 9 kinds.
- It is possible to convert mutually between decimal, binary, octal and hexadecimal, and the four operations in arithmetic in binary, octal and hexadecimal.
- One independent accumulating memory.

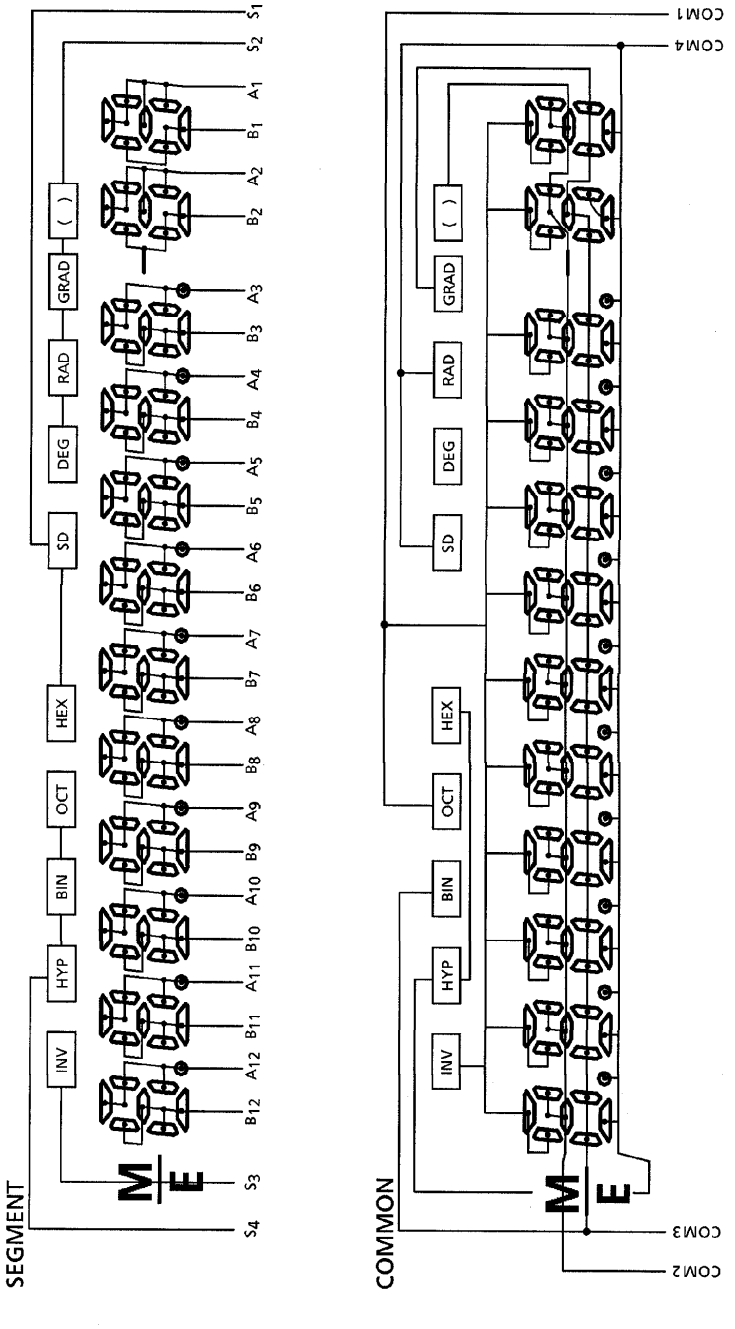
- It is possible to convert or fix the display number system by FLO (Floating) , SCI (Scientific) or ENG (Engineering) key.
- It is possible to specify decimal part digits (0~9) by FIX key.
- Direct drive for FEM LCD (1 / 3 prebias, 1 / 4 duty) .
- Automatic power on clear.
- Low power consumption. V_{SS} = – 3.0V single power supply.
- The 60 pin flat package is used.

SYSTEM BLOCK DIAGRAM



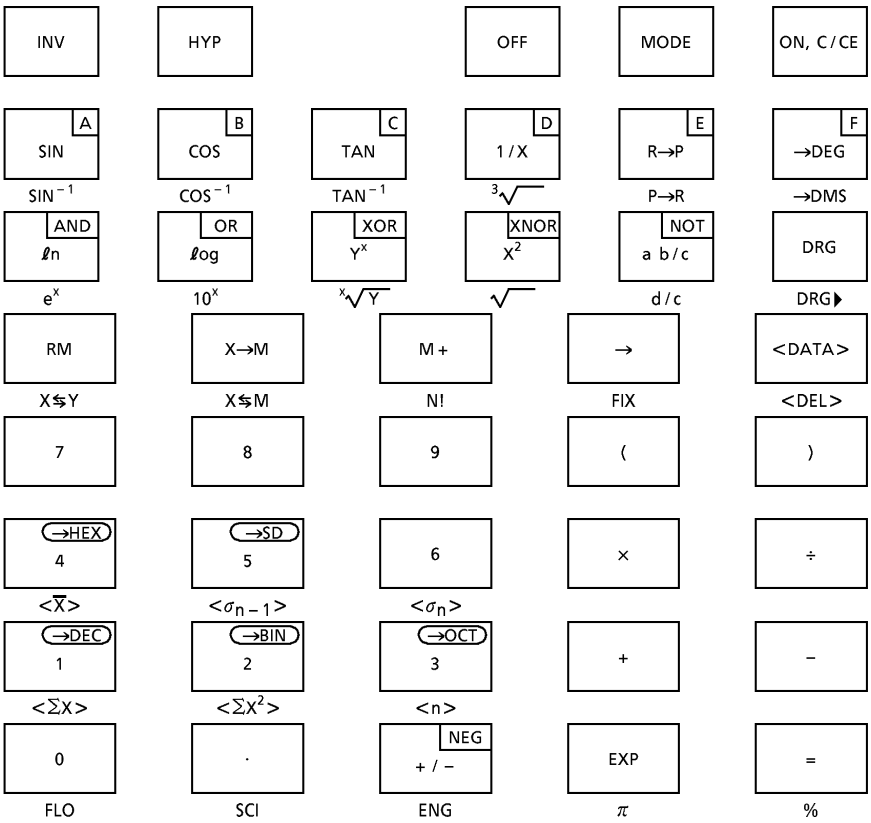
NOTE Input capacity ≦ 400 (pF) at V_{SS} = – 3.0 (V)
Key resistance ≦ 3.0 (kΩ) at V_{SS} = – 3.0 (V)

CONNECTION OF LCD

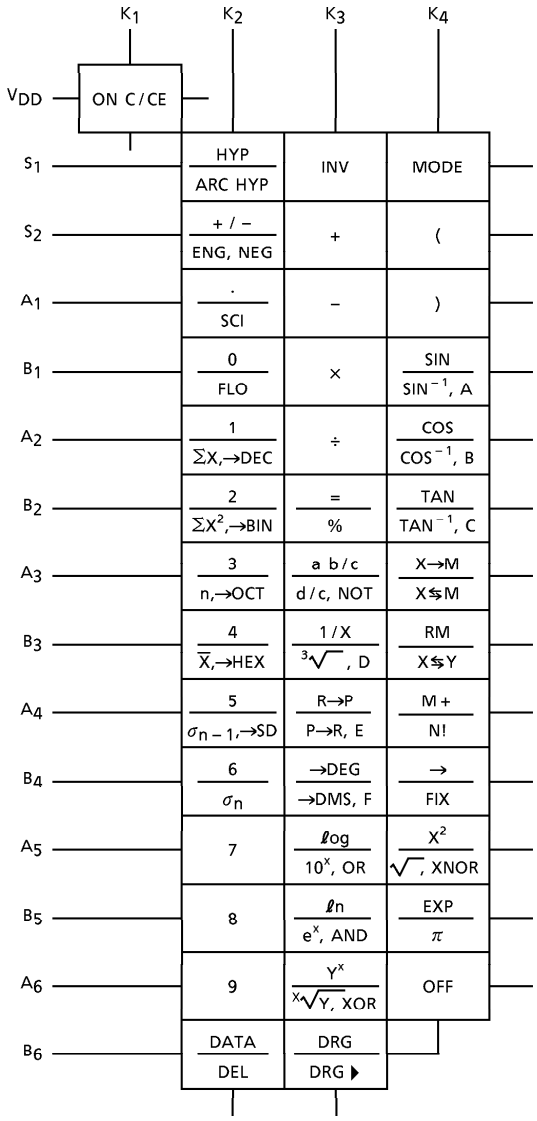


T7987A, JT7987AY-CS – 3

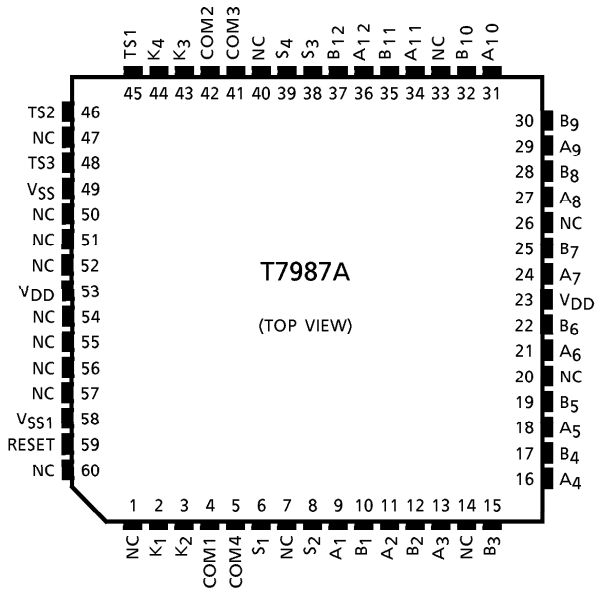
SET KEY LAYOUT (Example)



KEY LAYOUT


K1
K2
K3
K4
VDD
ON C/CE
S1
S2
A1
B1
A2
B2
A3
B3
A4
B4
A5
B5
A6
B6
HYP
ARC HYP
INV
MODE
+ / −
ENG, NEG
+
(
.
SCI
−
)
0
FLO
×
SIN
SIN−1, A
1
ΣX,→DEC
÷
COS
COS−1, B
2
ΣX2,→BIN
=
%
TAN
TAN−1, C
3
n,→OCT
a b/c
d/c, NOT
X→M
X⇆M
4
X̄,→HEX
1/X
3√ , D
RM
X⇆Y
5
σn − 1,→SD
R→P
P→R, E
M+
N!
6
σn
→DEG
→DMS, F
→
FIX
7
log
10x, OR
X2
√ , XNOR
8
ln
ex, AND
EXP
π
9
Yx
x√Y, XOR
OFF
DATA
DEL
DRG
DRG ▶

PIN LAYOUT



SPECIFICATION OF CALCULATOR

Speed of calculation

Key on 4.8ms Key off 34.4ms $f\phi WAIT = 15kHz$, $f\phi op = 80kHz$

The calculation speed doesn't include the key on or off time.

ITEM		OPERATION		CALCULATION SPEED (ms)
Number	DEC		5	8
		5	5	8
	HEX		A	9
		A	A	9
Function	DEC	5	+	20
		5	×	21
	HEX	A	−	51
		A	÷	52
4 operation	DEC	1 + 2	+	29
		1 0 0 0 0 0 0 0 0 0 − 1	−	31
		5 × 9	×	31
		5 5 5 5 5 × 9 9 9 9 9	×	36
		5 ÷ 9	÷	47
		5 5 5 5 5 ÷ 9 9 9 9 9	÷	58
	HEX	A B C + D E F	+	88
		A B C − D E F	−	144
		A B C × D E F	×	100
		A B C ÷ D E F	÷	98
Y^X, $\sqrt[X]{Y}$		3 Y^x 4	=	252
		3 $\sqrt[x]{Y}$ 4	=	262

ITEM	OPERATION			CALCULATION SPEED (ms)
SIN	DEG	3 0	SIN	241
	RAD	π ÷ 6 =	SIN	231
	GRAD	1 0 0 ÷ 3 =	SIN	350
COS	DEG	6 0	COS	244
	RAD	π ÷ 3 =	COS	311
	GRAD	2 0 0 ÷ 3 =	COS	354
TAN	DEG	4 5	TAN	118
	RAD	π ÷ 4 =	TAN	45
	GRAD	5 0	TAN	48
SIN^{-1}	DEG	0. 5	SIN^{-1}	252
	RAD	0. 5	SIN^{-1}	198
	GRAD	0. 5	SIN^{-1}	249
COS^{-1}	DEG	0. 5	COS^{-1}	322
	RAD	0. 5	COS^{-1}	230
	GRAD	0. 5	COS^{-1}	319
TAN^{-1}	DEG	1	TAN^{-1}	73
	RAD	1	TAN^{-1}	46
	GRAD	1	TAN^{-1}	72
Ln		2 0	ln	47
Log		2 0	ℓog	99
e^x		2 0	e^x	94
10^x		1. 2 3	10^x	113
		1 0	10^x	40
X!		6 9	N!	291
HYP		3 hyp	SIN	189
		3 hyp	COS	190
		3 hyp	TAN	232
ARC HYP		3 hyp^{-1}	SIN	184
		3 hyp^{-1}	COS	205
		0.5 hyp^{-1}	TAN	174
X^2		2 0	X^2	18
$\sqrt{}$		2 0	$\sqrt{}$	64
1 / X		2 0	1 / X	23
$\sqrt[3]{}$		2 0	$\sqrt[3]{}$	180
Mutual Conversion	DEC	1 2 3	→BIN	35
		1 2 3 4 5	→OCT	40
		1 2 3 4 5	→HEX	35
	BIN	1 0 1 0 1	→DEC	27
	OCT	1 2 3 4 5	→DEC	33
	HEX	A B C D E	→DEC	54
→DEG		1.2 3 4 5	→DEG	78
→DMS		1.2 3 4 5	→DMS	87

ITEM	OPERATION			CALCULATION SPEED (ms)
R→P	DEG	$\sqrt[3]{\ }$ X⇆Y 1	R→P	275
	RAD	$\sqrt[3]{\ }$ X⇆Y 1	R→P	216
	GRAD	$\sqrt[3]{\ }$ X⇆Y 1	R→P	274
P→R	DEG	2 X⇆Y 3 0	P→R	462
	RAD	2 X⇆Y 30 DRG▸	P→R	437
	GRAD	2 X⇆Y 30 DRG▸ DRG▸	P→R	626
→RAD	DEG	3 6 0	DRG▸	43
→GRAD	RAD	2 × π =	DRG▸	29
→DEG	GRAD	4 0 0	DRG▸	20
Memory		1 2 3	X→M	17
		1 2 3 X→M	M+	19
		1 2 3 X→M	RM	12
		1 2 3 X→M	X⇆M	19
%		1 2 3 + 4 5 6	%	26
		1 2 3 − 4 5 6	%	26
		1 2 3 × 4 5 6	%	17
		1 2 3 ÷ 4 5 6	%	17
Exchange		1 2 3 + 4 5 6	X⇆Y	15
Shift		1 2 3	→	8
Statistic Calculation	1 DATA 2 DATA 3 DATA …… 8 DATA 9		DATA	38
	The above-mentioned data		n	16
			$\bar{X}$	21
			ΣX	15
			ΣX^2	15
			σ_{n-1}	90
			σ_n	104
Logic operation	HEX	A B C AND D E F	=	181
		A B C OR D E F	=	195
		A B C XOR D E F	=	171
		A B C XNOR D E F	=	289
		A B C	NOT	118
NEG	HEX	A B C	NEG	112
Fractional number calculation	Function	2 ab/c 3 6 ab/c 2 3 4	−	75
		2 ab/c 3 6 ab/c 2 3 4	÷	76
	4-operation	2 _ 36⌟ 234 + 3 _ 45 ⌟ 345	=	161
		2 _ 36⌟ 234 − 3 _ 45 ⌟ 345	=	153
		2 _ 36⌟ 234 × 3 _ 45 ⌟ 345	=	149
		2 _ 36⌟ 234 ÷ 3 _ 45 ⌟ 345	=	168

OPERATION RANGE AND ACCURACY

FUNCTION	ANGLE UNIT	OPERATION RANGE	UNDER FLOW AREA	NORMAL ACCURACY
SIN X	DEG	$0 \leqq \|X\| \leqq 4.499999999 \times 10^{10}$	$0 \leqq \|X\| \leqq 5.729577951 \times 10^{-98}$	10 digits ± 1
	RAD	$0 \leqq \|X\| \leqq 785398163.3$	—	
	GRAD	$0 \leqq \|X\| \leqq 4.999999999 \times 10^{10}$	$0 \leqq \|X\| \leqq 6.366197723 \times 10^{-98}$	
COS X	DEG	$0 \leqq \|X\| \leqq 4.500000008 \times 10^{10}$	—	
	RAD	$0 \leqq \|X\| \leqq 785398164.9$	—	
	GRAD	$0 \leqq \|X\| \leqq 5.000000009 \times 10^{10}$	—	
TAN X	DEG	SAME AS SIN X except for $\|X\| = (2n-1) \cdot 90$	SAME AS SIN X	
	RAD	SAME AS SIN X except for $\|X\| = (2n-1) \cdot \pi / 2$	SAME AS SIN X	
	GRAD	SAME AS SIN X except for $\|X\| = (2n-1) \cdot 100$	SAME AS SIN X	
$SIN^{-1}X$	DEG	$0 \leqq \|X\| \leqq 1$	$0 \leqq \|X\| \leqq 1.570796326 \times 10^{-99}$	
	RAD	$0 \leqq \|X\| \leqq 1$	—	
	GRAD	$0 \leqq \|X\| \leqq 1$	$0 \leqq \|X\| \leqq 1.570796326 \times 10^{-99}$	
$COS^{-1}X$	DEG	SAME AS $SIN^{-1}X$	—	
	RAD	SAME AS $SIN^{-1}X$	—	
	GRAD	SAME AS $SIN^{-1}X$	—	
$TAN^{-1}X$	DEG	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	SAME AS $SIN^{-1}X$	
	RAD	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
	GRAD	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	SAME AS $SIN^{-1}X$	

FUNCTION	OPERATION RANGE	UNDER FLOW AREA	NORMAL ACCURACY
LN X	$0 < X$	—	10 digits ± 1
LOG X	$0 < X$	—	
e^X	$-9.999999999 \times 10^{99} \leqq X \leqq 230.2585092$	$-9.999999999 \times 10^{99} \leqq X \leqq -227.9559243$	
10^X	$-9.999999999 \times 10^{99} \leqq X \leqq 99.99999999$	$-9.999999999 \times 10^{99} \leqq X \leqq -99.00000001$	
X!	$0 \leqq X \leqq 69$ (INTEGER)	—	
$\frac{1}{X}$	$1 \times 10^{-99} \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	$1.000000001 \times 10^{99} \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	
X^2	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{49}$	$0 \leqq \|X\| \leqq 3.162277660 \times 10^{-50}$	
$\sqrt{X}$	$0 \leqq X \leqq 9.999999999 \times 10^{99}$	—	
$\sqrt[3]{X}$	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
DMS→DEG	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{9}$	—	
DEG→DMS	$0 \leqq \|X\| \leqq 9999999.999$	$0 \leqq \|X\| \leqq 1.388888888 \times 10^{-6}$	lowest digits ± 1

FUNCTION	OPERATION RANGE	UNDER FLOW AREA	NORMAL ACCURACY
SINH X	$0 \leqq \|X\| \leqq 230.2585092$	—	10 digits ±1
COSH X	$0 \leqq \|X\| \leqq 230.2585092$	—	
TANH X	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
$SINH^{-1}X$	$0 \leqq \|X\| \leqq 4.999999999 \times 10^{99}$	—	
$COSH^{-1}X$	$1 \leqq X \leqq 4.999999999 \times 10^{99}$	—	
$TANH^{-1}X$	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{-1}$	—	
R→P ($xy \rightarrow \gamma\theta$)	$\|x\|, \|y\| \leqq 9.999999999 \times 10^{49}$ $(x^2 + y^2) \leqq 9.999999999 \times 10^{99}$ $\frac{Y}{X}$; SAME AS $TAN^{-1}X$	$\frac{Y}{X}$; SAME AS $TAN^{-1}X$	
P→R ($\gamma\theta \rightarrow xy$)	$0 \leqq \gamma \leqq 9.999999999 \times 10^{99}$ θ ; SAME AS SIN X, COS X	θ ; SAME AS SIN X, COS X	
DEG→RAD	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	$0 \leqq \|X\| \leqq 5.729577951 \times 10^{-98}$	
RAD→GRAD	$0 \leqq \|X\| \leqq 1.570796326 \times 10^{98}$	—	
GRAD→DEG	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	$0 \leqq \|X\| \leqq 1.111111111 \times 10^{-99}$	
Y^X	$-9.999999999 \times 10^{99} \leqq X \cdot LN\ \|Y\| \leqq 230.2585092$	$-9.999999999 \times 10^{99} \leqq X \cdot LN\ \|Y\| \leqq -227.9559243$	10 digits ±1
	(1) Y>0…The above-mentioned operation range. (2) Y<0…X (Integer) or, 1/X (Odd, X≠0) …The above-mentioned operation range. (3) Y=0…0<X		
$\sqrt[X]{Y}$	$-9.999999999 \times 10^{99} \leqq \frac{1}{X} \cdot LN\ \|Y\| \leqq 230.2585092$	$-9.999999999 \times 10^{99} \leqq \frac{1}{X} \cdot LN\ \|Y\| \leqq -227.95593243$	10 digits ±1
	(1) Y>0…The above-mentioned operation range. (2) Y<0…X (Odd) or 1/X (Integer, X≠0) …The above-mentioned operation range. (3) Y=0…0<X		
→DEC	Operation range The following operation range after the conversion. $0 \leqq \|X\| \leqq 9999999999$		—
→BIN	The following operation range after the conversion. $1000000000 \leqq X \leqq 1111111111$ $0 \leqq X \leqq 111111111$		—
→OCT	The following operation range after the conversion. $4000000000 \leqq X \leqq 7777777777$ $0 \leqq X \leqq 3777777777$		—
→HEX	The following operation range after the conversion. FDABF41CO1≦X≦FFFFFFFFFF 0≦X≦2540BE3FF		—

FUNCTION		OPERATION RANGE	NORMAL ACCURACY
AND OR XOR XNOR		BIN ; $1000000000 \leqq X \leqq 1111111111$ $0 \leqq X \leqq 111111111$ OCT ; $4000000000 \leqq X \leqq 7777777777$ $0 \leqq X \leqq 3777777777$ HEX ; The following operation range after the operation. $FDABF41CO1 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FF$	—
NOT		BIN ; SAME AS AND OCT ; SAME AS AND HEX ; $FDABF41CO1 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FE$	—
NEG		BIN ; $1000000001 \leqq X \leqq 1111111111$ $0 \leqq X \leqq 111111111$ OCT ; $4000000001 \leqq X \leqq 7777777777$ $0 \leqq X \leqq 3777777777$ HEX ; $FDABF41CO1 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FF$	—
Statistic	DATA DEL	$\lvert x \rvert \leqq 9.999999999 \times 10^{49}$ $\lvert \Sigma x \rvert \leqq 9.999999999 \times 10^{99}$ $\Sigma x^2 \leqq 9.999999999 \times 10^{99}$ $0 \leqq n \leqq 9999999999$. n = Integer	10 digits ± 1
	$\bar{x}$	$n \neq 0$	
	$\sigma n-1$	$n \neq 1,\ n \neq 0$ $0 \leqq \frac{\Sigma X^2 - \{(\Sigma X)^2 / n\}}{n-1} \leqq 9.999999999 \times 10^{99}$	
	σn	$n \neq 0$ $0 \leqq \frac{\Sigma X^2 - \{(\Sigma X)^2 / n\}}{n} \leqq 9.999999999 \times 10^{99}$	

MAXIMUM RATINGS (Ta = 25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{SS}	+ 0.3 ~ − 3.5	V
Input Voltage	V_{IN}	+ 0.3 ~ V_{SS} − 0.3	V
Operating Temperature	T_{opr}	0 ~ 40	°C
Storage Temperature	T_{stg}	− 55 ~ 125	°C

ELECTRICAL CHARACTERISTICS (V_{SS} = −3.0 ± 0.2V, V_{DD} = 0V, Ta = 25 ± 1.5°C)

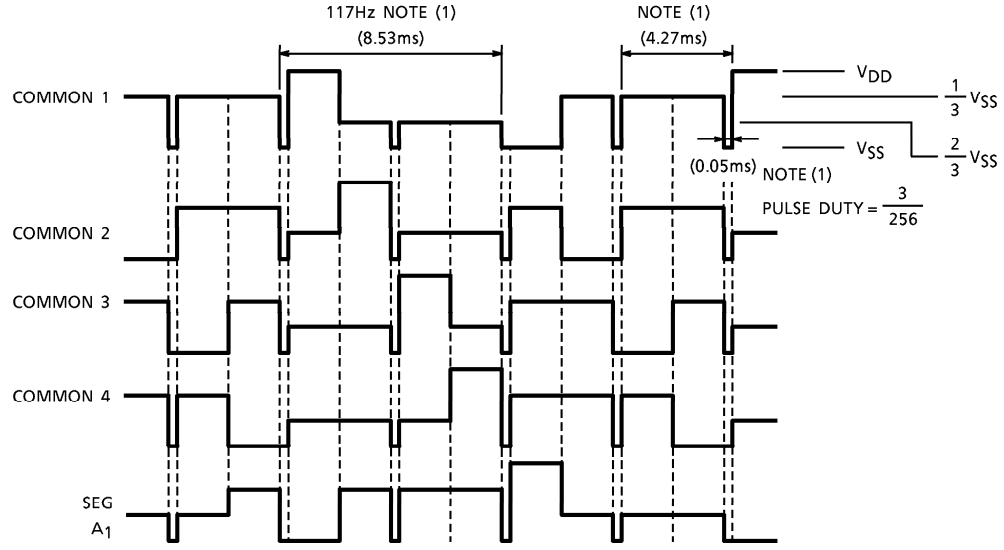
PARAMETER	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	—	—	—	—	−2.5	−3.0	−3.4	V
Supply Current	I_{DD} WAIT	—	—	V_{SS} = −3.0V, wait	—	20	35	μA
Supply Current	I_{DD} OP	—	—	V_{SS} = −3.0V, operate	—	70	120	μA
Supply Current	I_{DD} OFF	—	—	V_{SS} = −3.0V, off	—	1	3	μA
Oscillating Frequency	Fϕ WAIT	—	—	V_{SS} = −3.0V, wait	9	15	21	kHz
Oscillating Frequency	Fϕ OP	—	—	V_{SS} = −3.0V, operate	48	80	112	kHz
Fram Frequency	f_F	—	—	V_{SS} = −3.0V, wait	70	117	164	Hz
Timer	T timer	—	—	V_{SS} = −3.0V	430	603	1005	s
"1" Input Voltage	V_{IH}	—	K_1~K_4 RESET	—	V_{SS} +0.5	—	V_{SS}	V
"0" Input Voltage	V_{IL}	—	K_1~K_4 RESET	—	V_{DD}	—	−0.5	V
"1" Output Resistance	R_{KEY}	—	SEG	V_{OUT} = V_{SS} + 0.5V : KEY STROBE	—	—	2	kΩ
"0" Output Resistance	R_{SEG} (L)	—	SEG	V_{OUT} = V_{DD} − 0.5V	—	—	90	kΩ
"1" Output Resistance	R_{SEG} (H)	—	SEG	V_{OUT} = V_{SS} + 0.5V : $\overline{\text{KEY STROBE}}$	—	—	90	kΩ
"0" Output Resistance	R_{COM} (L)	—	COM	V_{OUT} = V_{DD} − 0.5V	—	—	25	kΩ
"1" Output Resistance	R_{COM} (H)	—	COM	V_{OUT} = V_{SS} + 0.5V	—	—	25	kΩ
KEY Pull Up Resistance	$R_{PULL\ UP}$	—	K_1	V_{OUT} = 0V (Note 1)	27	45	63	kΩ
KEY Pull Down Resistance	$R_{PULL\ DOWN}$	—	K_2~K_4	V_{OUT} = V_{SS} (Note 1)	27	45	63	kΩ
KEY Pull Up Resistance	R_{RESET} (H)	—	RESET	V_{OUT} = 0V	24	40	56	kΩ
KEY Pull Down Resistance	R_{RESET} (L)	—	RESET	V_{OUT} = V_{DD} − 0.5V	—	—	10	kΩ
"M" Output Resistance	R_{OM}	—	SEG	$V_{OUT} = \frac{1}{3}V_{SS} - 0.5V$	—	125	—	kΩ
"M" Output Resistance	R_{OM}	—	SEG	$V_{OUT} = \frac{2}{3}V_{SS} + 0.5V$	—	125	—	kΩ
"M" Output Resistance	R_{OM}	—	COM	$V_{OUT} = \frac{1}{3}V_{SS} - 0.5V$	—	85	—	kΩ
"M" Output Resistance	R_{OM}	—	COM	$V_{OUT} = \frac{2}{3}V_{SS} + 0.5V$	—	85	—	kΩ
"1" Output Voltage	V_{OH}	—	RESET	—	V_{SS} +0.2	V_{SS}	V_{SS}	V

PARAMETER	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
"0" Output Voltage	V_{OL}	—	RESET	—	V_{DD}	V_{DD}	V_{DD} − 0.2	V
"1" Output Voltage	V_{OH}	—	K_1	(Note 1)	V_{SS} + 0.2	V_{SS}	V_{SS}	V
"0" Output Voltage	V_{OL}	—	K_2~K_4	(Note 1)	V_{DD}	V_{DD}	V_{DD} − 0.2	V
"1" Output Voltage	V_{OH}	—	SEG COM	—	V_{SS} + 0.2	V_{SS}	V_{SS}	V
"M" Output Voltage	V_{OM}	—	SEG COM	—	2 / 3 V_{SS} + 0.2	2 / 3 V_{SS}	2 / 3 V_{SS} − 0.2	V
"M" Output Voltage	V_{OM}	—	SEG COM	—	1 / 3 V_{SS} + 0.2	1 / 3 V_{SS}	1 / 3 V_{SS} − 0.2	V
"0" Output Voltage	V_{OL}	—	SEG COM	—	V_{DD}	V_{DD}	V_{DD} − 0.2	V

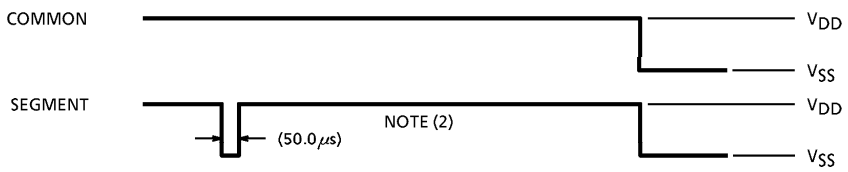
(Note 1) The key buffer is high impedance at $\overline{\text{keystrobe}}$.

WAVEFORMS FOR DISPLAY

Display



Key pulse output



NOTE (1) FϕWAIT = 15kHz
NOTE (2) FϕOP = 80kHz

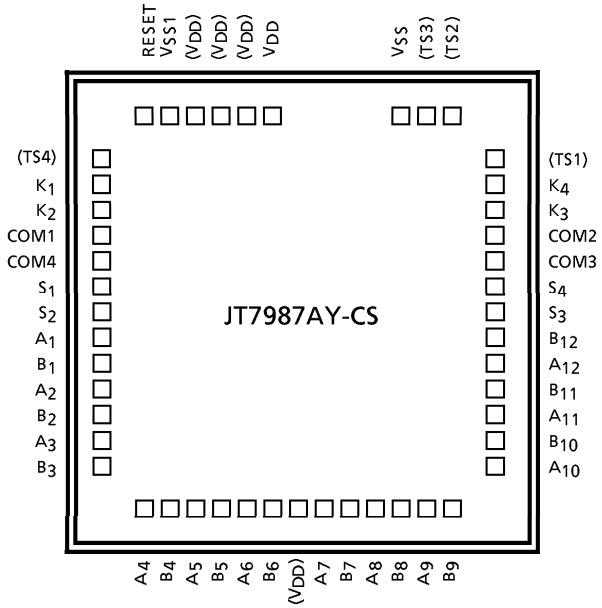
PAD LOCATION TABLE (μm)

NAME	X POINT	Y POINT
RESET	– 890	1451
V_{SS1}	– 731	1451
(V_{DD})	– 505	1451
(V_{DD})	– 346	1451
(V_{DD})	– 186	1451
V_{DD}	8	1451
V_{SS}	574	1451
*(TS3)	734	1451
*(TS2)	1055	1451
*(TS1)	1270	993
K_4	1270	829
K_3	1270	666
COM2	1270	503
COM3	1270	339
S_4	1270	175
S_3	1270	13
B_{12}	1270	– 149
A_{12}	1270	– 315
B_{11}	1270	– 478
A_{11}	1270	– 641
B_{10}	1270	– 805
A_{10}	1270	– 968
B_9	1076	– 1414
A_9	888	– 1414

NAME	X POINT	Y POINT
B_8	715	– 1414
A_8	553	– 1414
B_7	390	– 1414
A_7	228	– 1414
(V_{DD})	0	– 1414
B_6	– 231	– 1414
A_6	– 393	– 1414
B_5	– 555	– 1414
A_5	– 717	– 1414
B_4	– 879	– 1414
A_4	– 1069	– 1414
B_3	– 1270	– 958
A_3	– 1270	– 795
B_2	– 1270	– 631
A_2	– 1270	– 468
B_1	– 1270	– 304
A_1	– 1270	– 141
S_2	– 1270	23
S_1	– 1270	186
COM4	– 1270	350
COM1	– 1270	513
K_2	– 1270	676
K_1	– 1270	840
*(TS4)	– 1270	1003

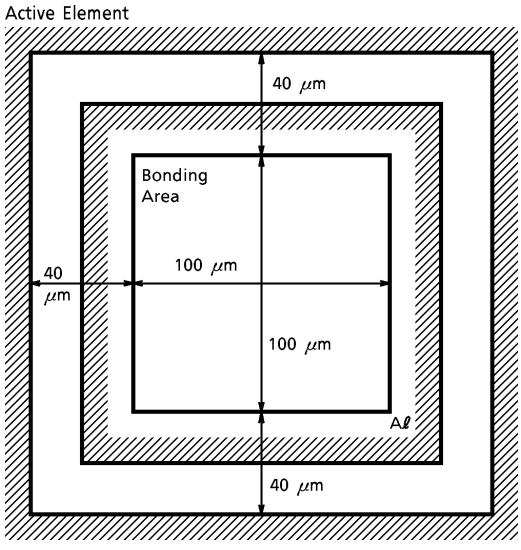
*( ) Do not connect.

CHIP LAYOUT



Chip size : 2.99 × 3.33 (mm)
Chip thickness : 200 ± 30 (μm)
Substrate : V_{DD}

PAD LAYOUT

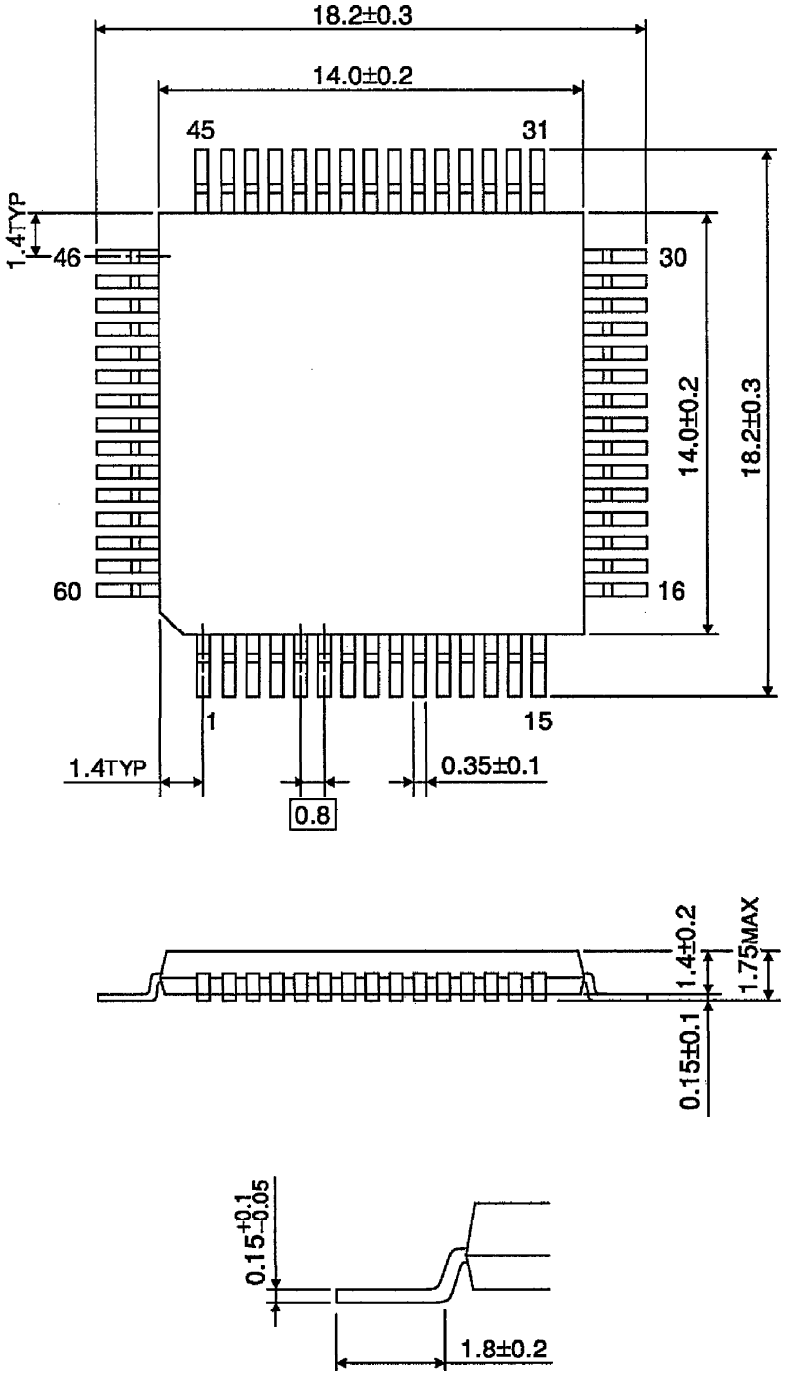


Scribe Line

PAD Pitch 160 μm

OUTLINE DRAWING

LQFP60-P-1414-0.80 Unit : mm



Weight : 0.66g (Typ.)

GENERAL SPECIFICATION FOR CALCULATOR LSI BARE CHIP

1. Purpose

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

2. Definition

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

3. Priority of specifications

   When the discrepancies or questions happen to the specifications and instructions provided by VENDOR, the priority shall be ranked as follows.

   1) Individual specification for the calculator LSI bare chip.
      (Both PURCHASER and VENDOR are confirmed by the special sheets.)
   2) General specifications for the calculator LSI bare chip.
   3) Other related specifications and standards.

4. Characteristics

   To be shown in the individual specification sheets.
   The individual specification shall consist of the following 4 items in principle.

   1) Rated specifications.
   2) Electrical characteristics.
   3) Pin configuration & mechanical dimensions.
   4) Others.

5. Inspection of product for delivery

   5.1 Inspection lot

   a) Inspection lot shall consist of products produced by same material under same design, through same production process, and same facilities and assured same quality by same quality assurance method, and lot number shall be put on all trays to be able to trace the lot history.

   b) The quantity of products per Inspection lot shall consist of all 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 specified in following table :

TEST ITEM	AQL (%)
Electrical	2.5
Visual	4.0

5.3 Electrical criteria

Criteria of 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 after PURCHASER receives the quantity of products in principle.

b) PURCHASER shall report the results of incoming inspection to VENDOR and provide VENDOR with detailed data in failure rate and items regarding VENDOR's lot number respectively, if VENDOR demands the report from PURCHASER.

6.2 Inspection procedure

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

a) First : Visual inspection should be done.

b) Next : Electrical and other inspection should be done under condition with bare chip before going into PURCHASER's process.

7. Treatment for defective lot and products

Regarding the defective lot and defective products which are found through PURCHASER's incoming inspection, PURCHASER can be returned to VENDOR with detailed description on failures concerned.
However, if VENDOR cannot receive the defective items within 30 days after PURCHASER's incoming inspection, VENDOR should be able to make no reference to the defective problem.

8. Packing and labeling

a) Dice shall be placed in die tray with the top metalization facting up in order.

b) In principle, a pile consists of 5 trays and several piles are packed in a package. These piles and packages are indicated with printed labels as shown below.

Date	
Name	
Lot No.	
Net	
TOSHIBA MADE IN JAPAN	

c) PURCHASER shall return these packing materials to VENDOR on VENDOR's demand.

9. Storage criteria

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

9.1 Chips must be stored under proper conditions to insure that they are not subjected to a moist and / or contaminated atmosphere that 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 to prevent even the slightest physical damage to the chip.

9.3 During mounting and lead bounding of chips the user must use proper assembly techniques to obtain proper electrical, thermal, and mechanical performance.

9.4 After the chip has been mounted and bounded, any necessary procedure must be followed by the user to insure that these non-hermetic chips are not subjected to 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 environments which could conceivably adversely affect their proper performance.

10. Handling criteria

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

10.1 Grounding

a) Bonders, pellet pickup tools, table tops, trim and form tools, sealing equipment, and other equipment used in chip handling should be properly grounded.

b) Operator should be properly grounded.

10.2 In-process handling

a) Assemblies or subassemblies of chips should be transported and stored in conductive carriers.

b) All external leads of the assemblies or subassemblies should be shorted together.

VISUAL INSPECTION CRITERIA

1. Visual inspection magnification shall be 40 × in principle.
2. Defects defined :

2.1 Thickness

See the technical data sheet.

2.2 Chip and crack

A die shall be rejected if :

a) Any crack of chip extends greater than 35μm in length into the inside of the scribble line. (see Fig.1)

2.3 Metallization

A die shall be rejected if :

a) More than 25% of the designed area of the metallization is missing at any bonding pad.

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

2.4 Glass protection coat

A die shall be rejected if :

a) It exhibits glass protection coat which covers more than 25% of any active bonding pad.

2.5 Attached foreign material

A die shall be rejected if :

a) A die is covered by stains or attached foreign material which size is more than 5 times as large as a bonding pad area.

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

2.6 Others

A die shall be rejected if :

a) There have no evident probed impression on the bonding pads.

b) A inked die, defective die, is intermized.

3. Limit samples should be fized, if necessary.

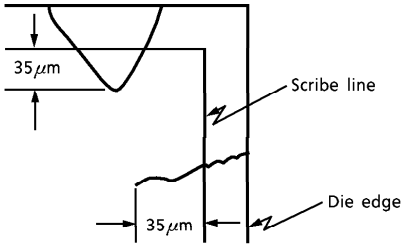


Fig.1

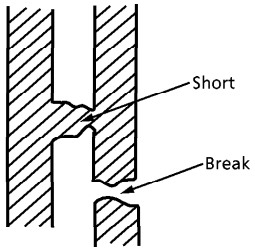


Fig.2 Lead pattern

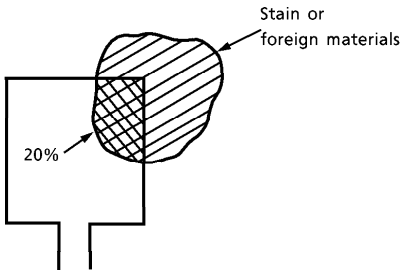
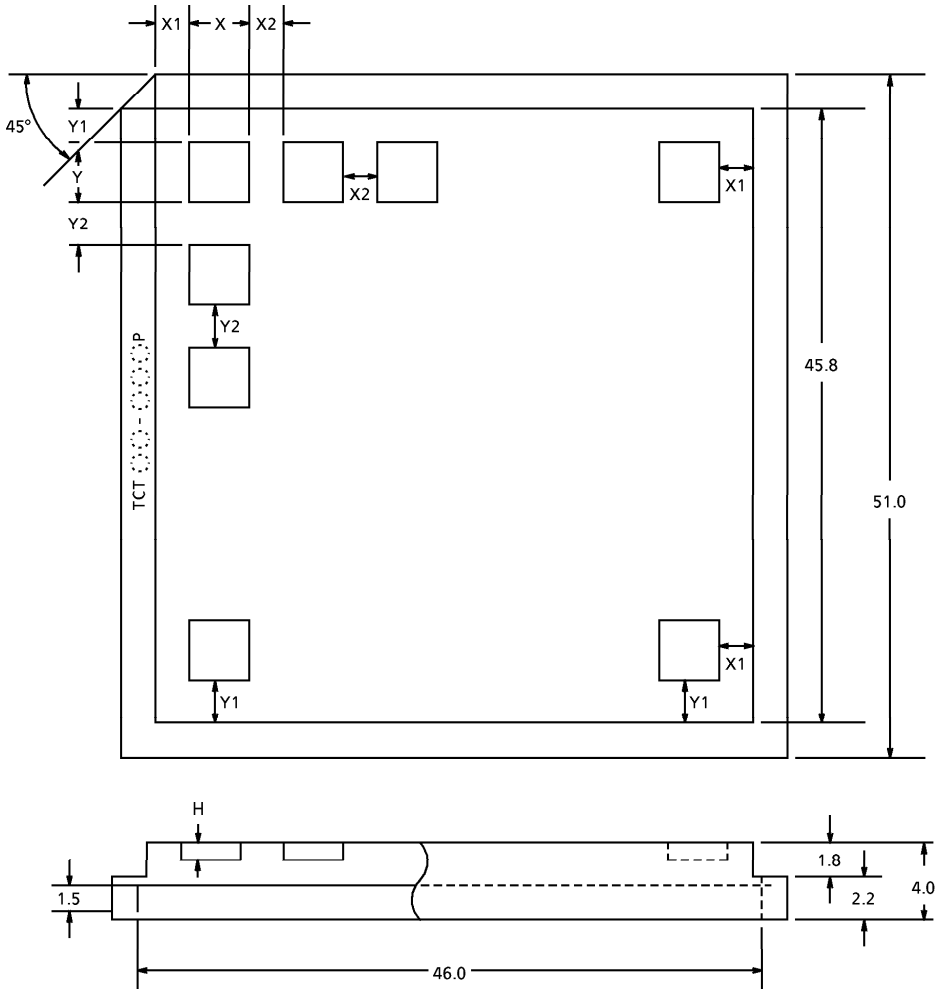


Fig.3

OUTSIDE DIMENSIONS OF CHIP TRAY



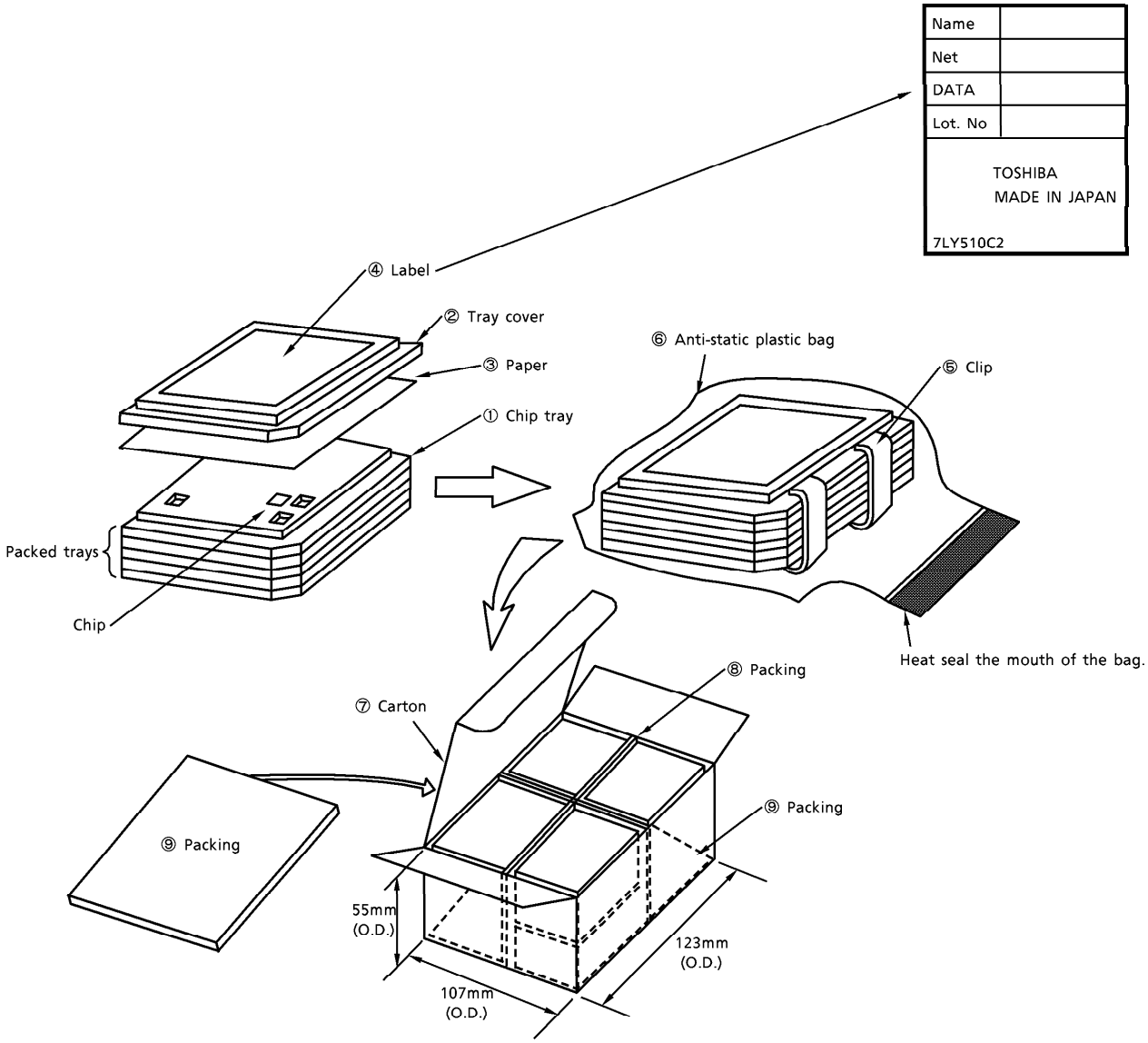
Unit : mm

CHIP NAME	TRAY NAME	X	Y	(H)	No. OF POCKETS	X1	X2	Y1	Y2
JT7987AY-CS	TCT38-060P	3.80	3.80	0.60	10 × 10 (100)	1.200	0.600	1.200	0.600

Tray material :

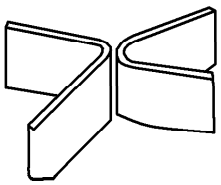
Carbon-containing polypropylene

PACKING METHOD-1



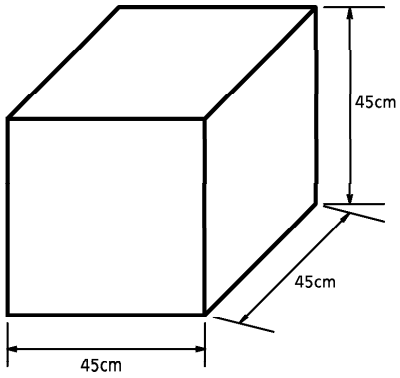
Place eight bags of chip trays in each carton box ⑦. Lay one sheet of packing ⑨ (7UF44F) before closing the lid of the cart box. (See the diagram above.)

Prepare packing ⑧ by cutting 7UF44F into halves and folding each in half as shown below ; use them as inner partitions.



PACKING METHOD-2

Shipping box



- Inner box : Containing 20 boxes
- Weight : Approx. 15kg (including packing material)
- Material : Corrugated cardboard
- IC contents : 36×5×8×20=28.8kpcs.