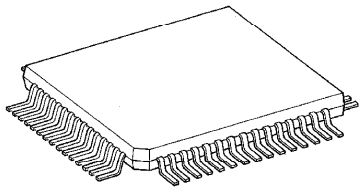
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T7987A, JT7987AY-CS

T7987A, JT7987AY-CS SINGLE-CHIP CMOS LSI FOR LCD CALCULATORS

The T7987A, JT7987AY-CS is single-chip microcomputer for 10-digit + 2-digit scientific calculation.
T7987A, JT7987AY-CS is the complete single-chip CMOS LSI for calculator with 10 digits, 67 functions, 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

- 12-digit display 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

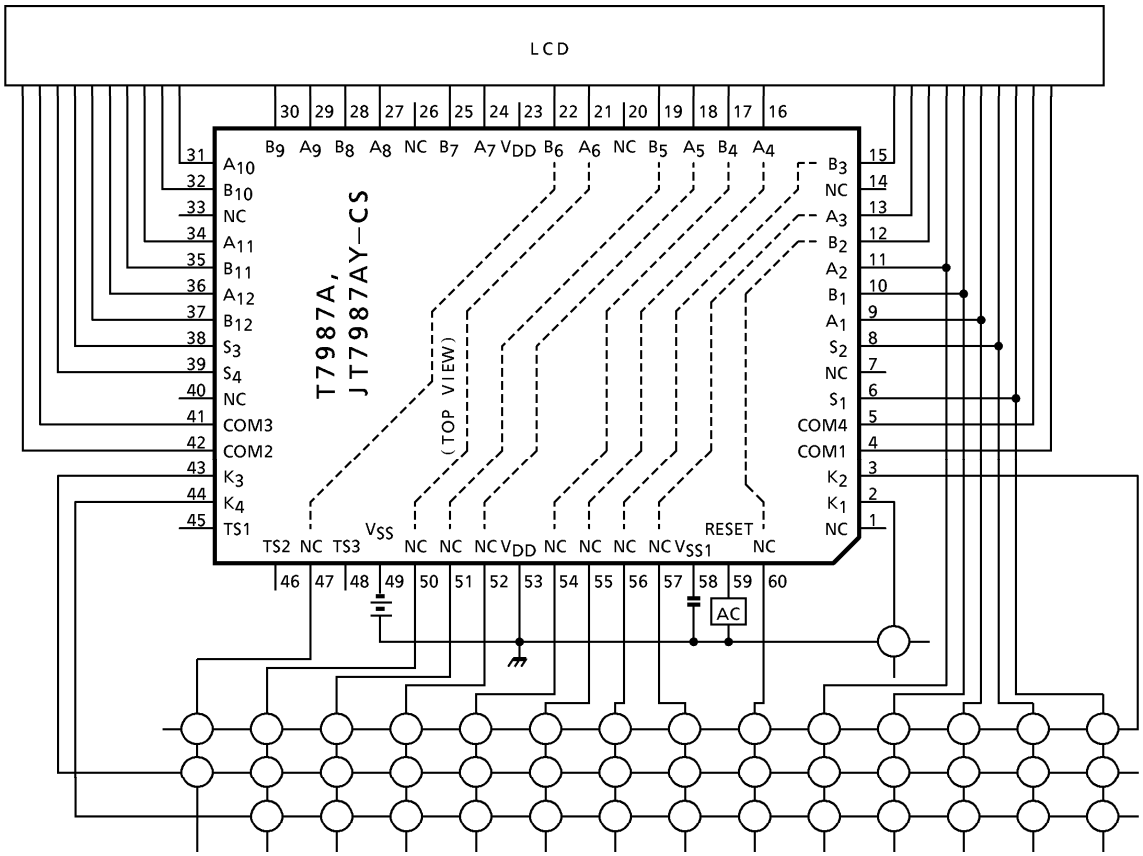
    Mantissa 10 digits plus negative code 1 digit.
- 13 kinds of special display

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.

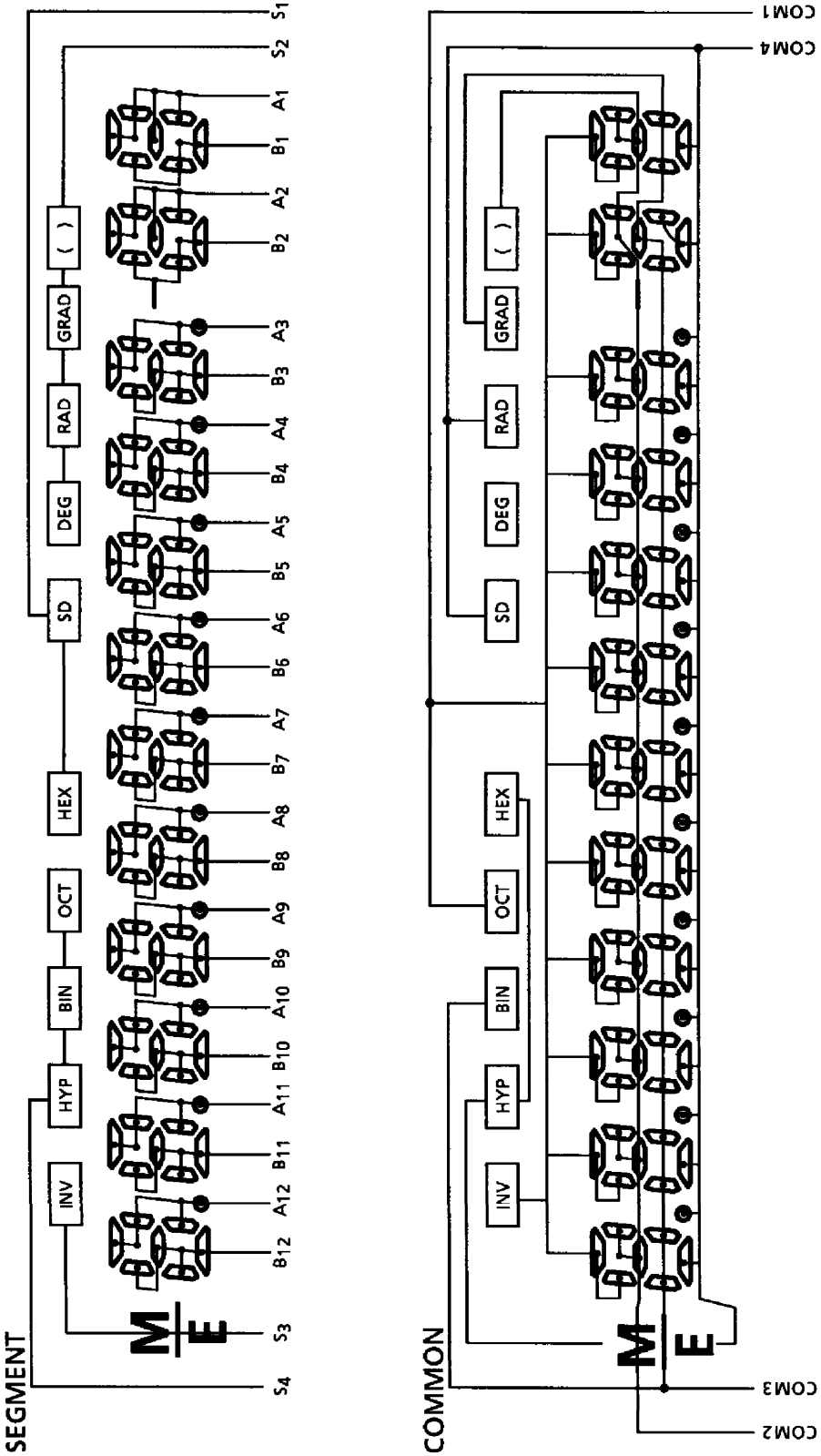
- It is possible to convert or fix the display number system by FLO (Floating), SCI (Scientific) or ENG (Engineering) key.
- It is possible to specify decimal part digits (0~9) by FIX key.
- Direct drive for FEM LCD (1/3 prebias, 1/4 duty).
- Automatic power on clear.
- Low-power consumption. V_{SS}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

SYSTEM BLOCK DIAGRAM



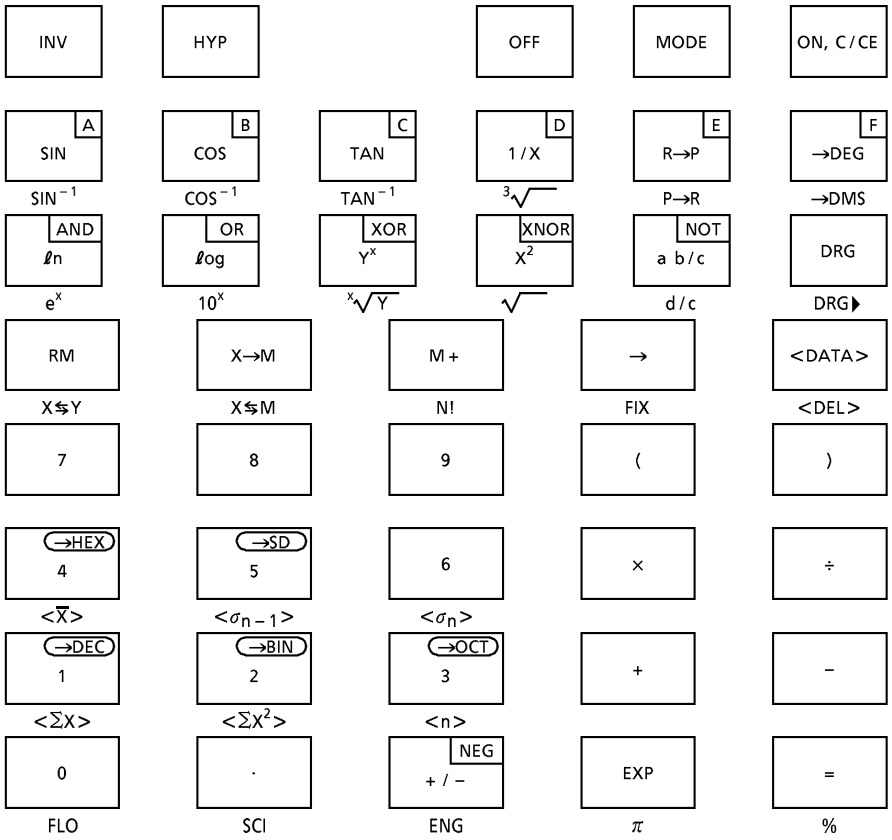
(Note) Input capacity ≦ 400 (pF) at V_{SS} = −3.0 (V)
Key resistance ≦ 3.0 (kΩ) at V_{SS} = −3.0 (V)

CONNECTION OF LCD

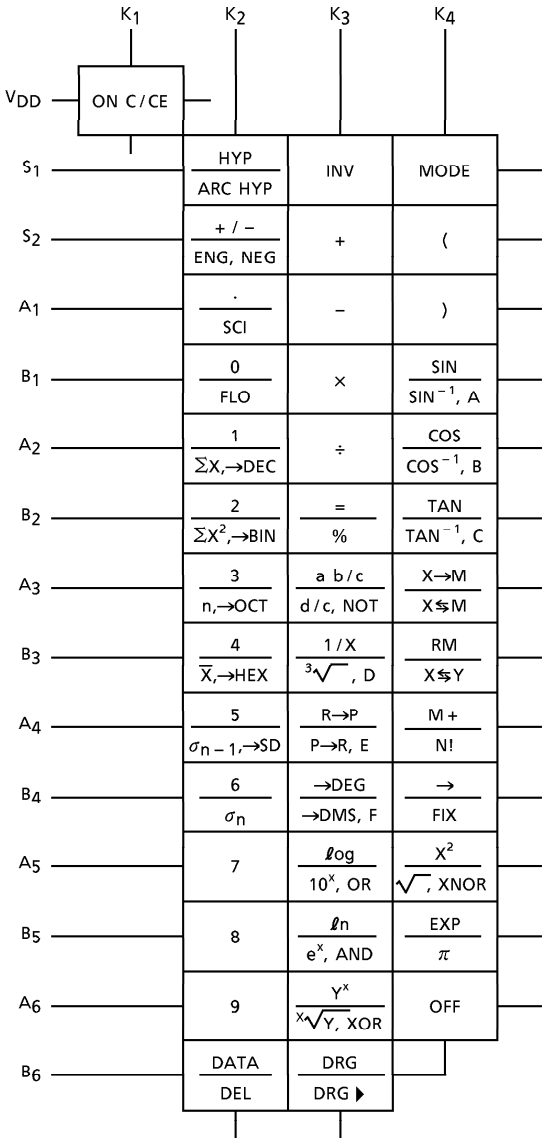


T7987A, JT7987AY-CS – 03

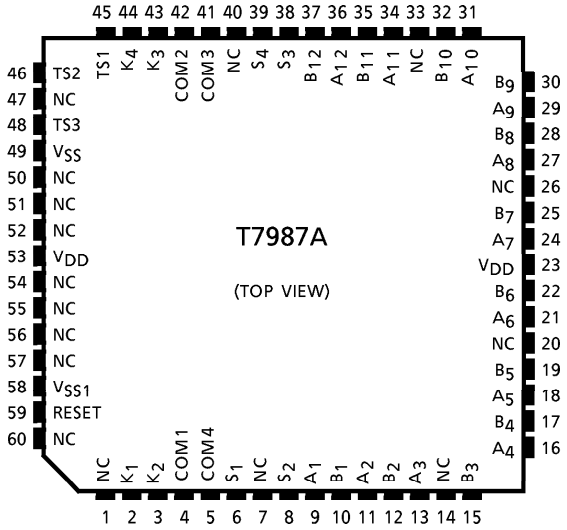
SET KEY LAYOUT (Example)



KEY CONNECTION



PIN ASSIGNMENT



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
			$\overline{X}$	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	$0 \leqq \|X\| \leqq 4.499999999 \times 10^{10}$	$0 \leqq \|X\| \leqq 5.729577951 \times 10^{-98}$	±1 in 10th significant digit
	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 $SIN^{-1}X$	
LN X		$0 < X$	—	
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		$0 \leqq \|X\| \leqq 9999999.999$	$0 \leqq \|X\| \leqq 1.388888888 \times 10^{-6}$	±1 in least significant digit

FUNCTION	OPERATION RANGE	UNDER FLOW AREA	NORMAL ACCURACY
SINH X	$0 \leqq \|X\| \leqq 230.2585092$	—	±1 in 10th significant digit
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	$-9.999999999 \times 10^{99}$ $\leqq X \cdot LN \|Y\| \leqq 230.2585092$	$-9.999999999 \times 10^{99}$ $\leqq X \cdot LN \|Y\| \leqq -227.9559243$	±1 in 10th significant digit
	(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		
$\sqrt[X]{Y}$	$-9.999999999 \times 10^{99}$ $\leqq \frac{1}{X} \cdot LN \|Y\| \leqq 230.2585092$	$-9.999999999 \times 10^{99}$ $\leqq \frac{1}{X} \cdot LN \|Y\| \leqq -227.95593243$	±1 in 10th significant digit
	(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≦X≦1111111111 0≦X≦ 111111111		—
→OCT	The following operation range after the conversion. 4000000000≦X≦7777777777 0≦X≦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	±1 in 10th significant digit
	$\bar{x}$	$n \neq 0$	
	$\sigma n-1$	$n \neq 1,\ n \neq 0$ $0 \leqq \frac{\Sigma X^2 - \{(\Sigma X)^2 / n\}}{n-1} \leqq 9.999999999 \times 10^{99}$	
	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)

CHARACTERISTICS	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)

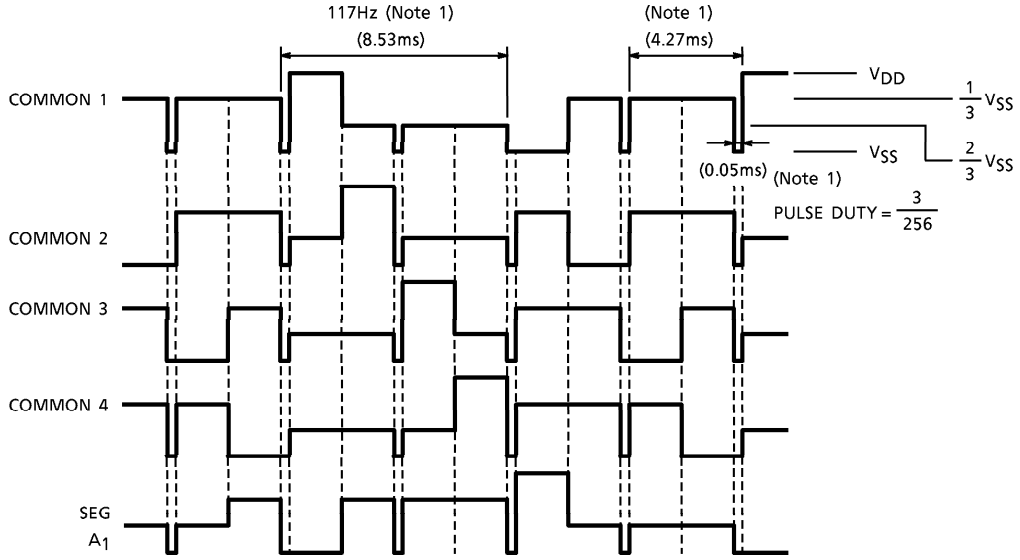
CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	—	—	—	—	−2.5	−3.0	−3.4	V
Supply Current	I_{DD} WAIT	—	—	V_{SS} = −3.0V, wait	—	20	35	μA
Supply Current	I_{DD} OP	—	—	V_{SS} = −3.0V, operate	—	70	120	μA
Supply Current	I_{DD} OFF	—	—	V_{SS} = −3.0V, off	—	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

CHARACTERISTICS	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

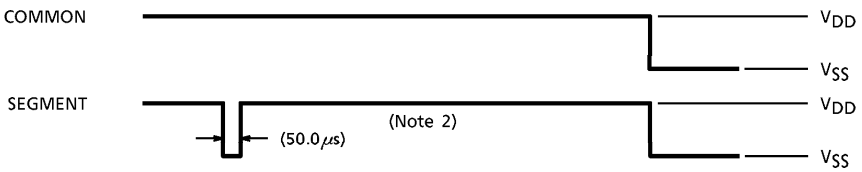
(Note 1) The key buffer is high impedance at $\overline{\text{keystrobe}}$.

WAVEFORMS FOR DISPLAY

Display



Key pulse output



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

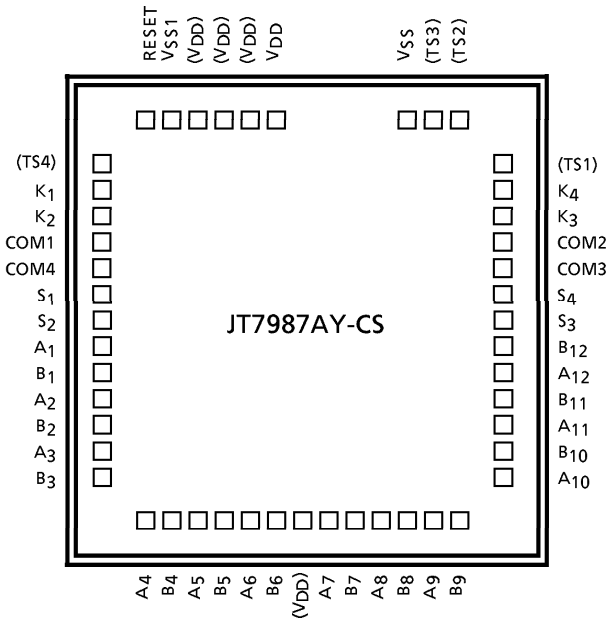
PAD LOCATION TABLE (μm)

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

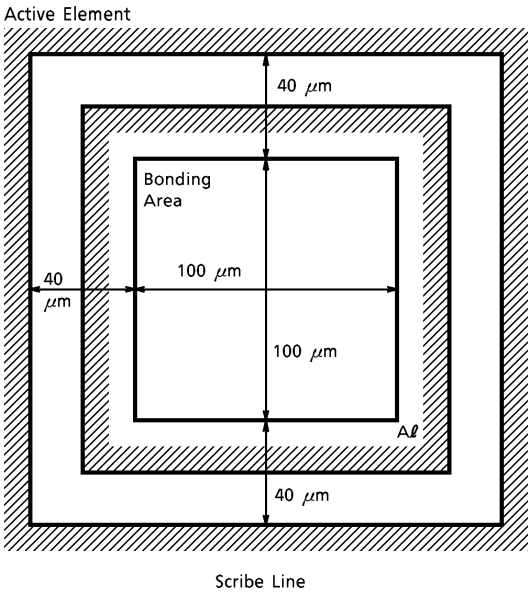
(Note) ( ) Do not connect.

CHIP LAYOUT



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

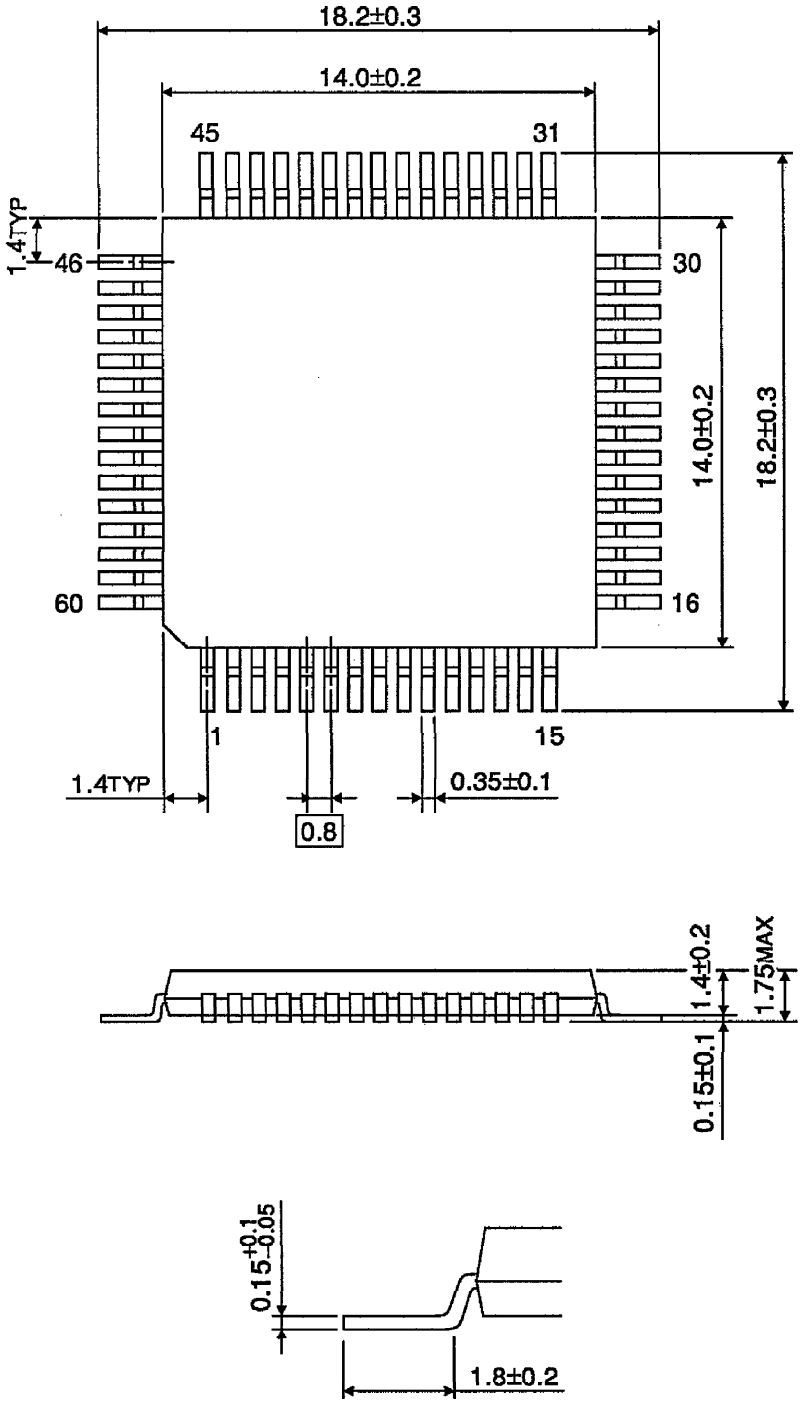
PAD LAYOUT



PAD Pitch 160 μm

PACKAGE DIMENSIONS

LQFP60-P-1414-0.80 Unit : mm



Weight : 0.66g (Typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

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