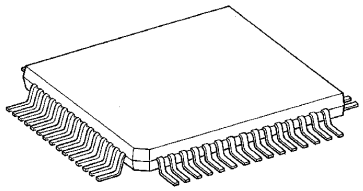
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T7942S

T7942S SINGLE-CHIP CMOS LSI FOR LCD CALCULATORS

The T7942S is single-chip microcomputer for 10-digit + 2-digit scientific caluculation.
T7942S is the complete single-chip CMOS LSI for electronic programmable scientific calculator with 10 digits, 129 functions, max. 4 formula-128 steps program capacity, 3 expression and hexadecimal, octal and binary, 1 variable and 2 variable statistic calculation, complex, fractional number calculation, metric conversion, physical constants and logic operation with the following features.



LQFP60-P-1414-0.80

Weight : 0.66g (Typ.)

FEATURES

- 12-digit display plus 2-digit 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.
- 20 kinds of special display

M	Memory	HEX	Hexadecimal mode
–	Mantissa and exponent minus	SD1	1 variable statistic calculation mode
E	Error	SD2	2 variable statistic calculation mode
INV	Inverse	DEG	Degree
HYP	Hyperbolic	RAD	Radian
BIN	Binary mode	GRAD	Gradian
OCT	Octal mode	( )	Parenthesis calculation
LRN1	Program write mode 1	LRN2	Program write mode 2
LRN3	Program write mode 3	LRN4	Program write mode 4
HLT	Program HALT	CPLX	Complex number calculation 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.

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- Mutual conversion between decimal, binary, octal and hexadecimal, and the 4 operations in arithmetic in binary, octal and hexadecimal are possible.
- Program function
  4 formula (LRN1~LRN4) total 128 steps.
  X>0, X≦M and GO TO judge function (It is possible to jump after and back within 9 steps).
  It is possible to display in the middle of result by HLT key.
  It is possible to enter the variable by ENT.
- 16 kinds of metric conversion
  oz<->g, J<->cal, Lb<->kg, in<->cm, gal<->l, °F<->°C, mmHg<->Kpa, atm<->MPa
- 13 kinds of physical constants
  G, g, εo, μo, Vm, ch, R, NA, k, me, u, e.
- One independent accumulating memory and 9 storage 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.
- + / − key is possible to enter as first key (According to sequence a mathematical formula).
- Direct drive for FEM LCD (1/3 prebias, 1/4 duty).
- Automatic power on clear and auto power off timer (about 10 minutes).
- Low power consumption. V_{SS} = −3.0V single power supply.
- The 60 pin flat package is used.

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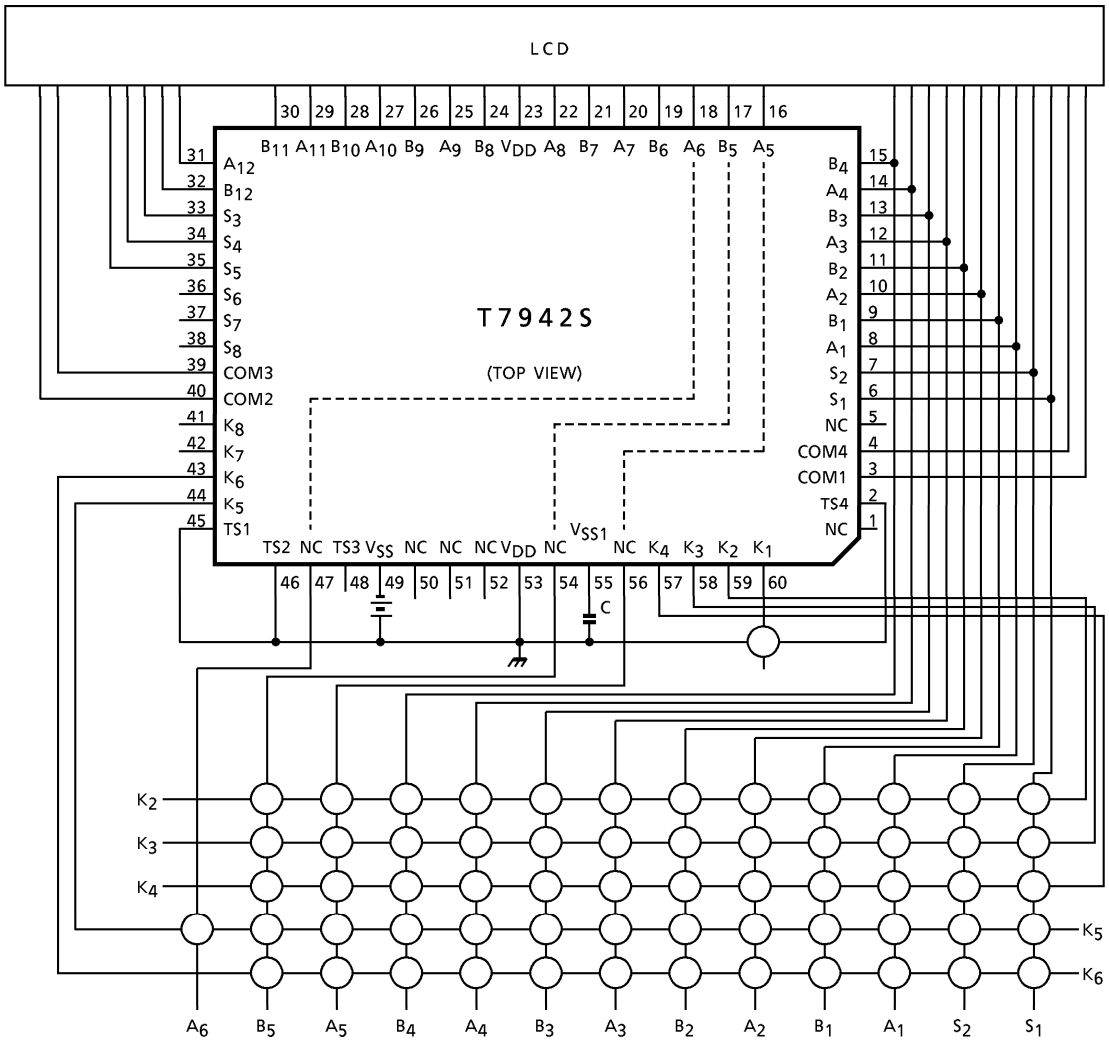
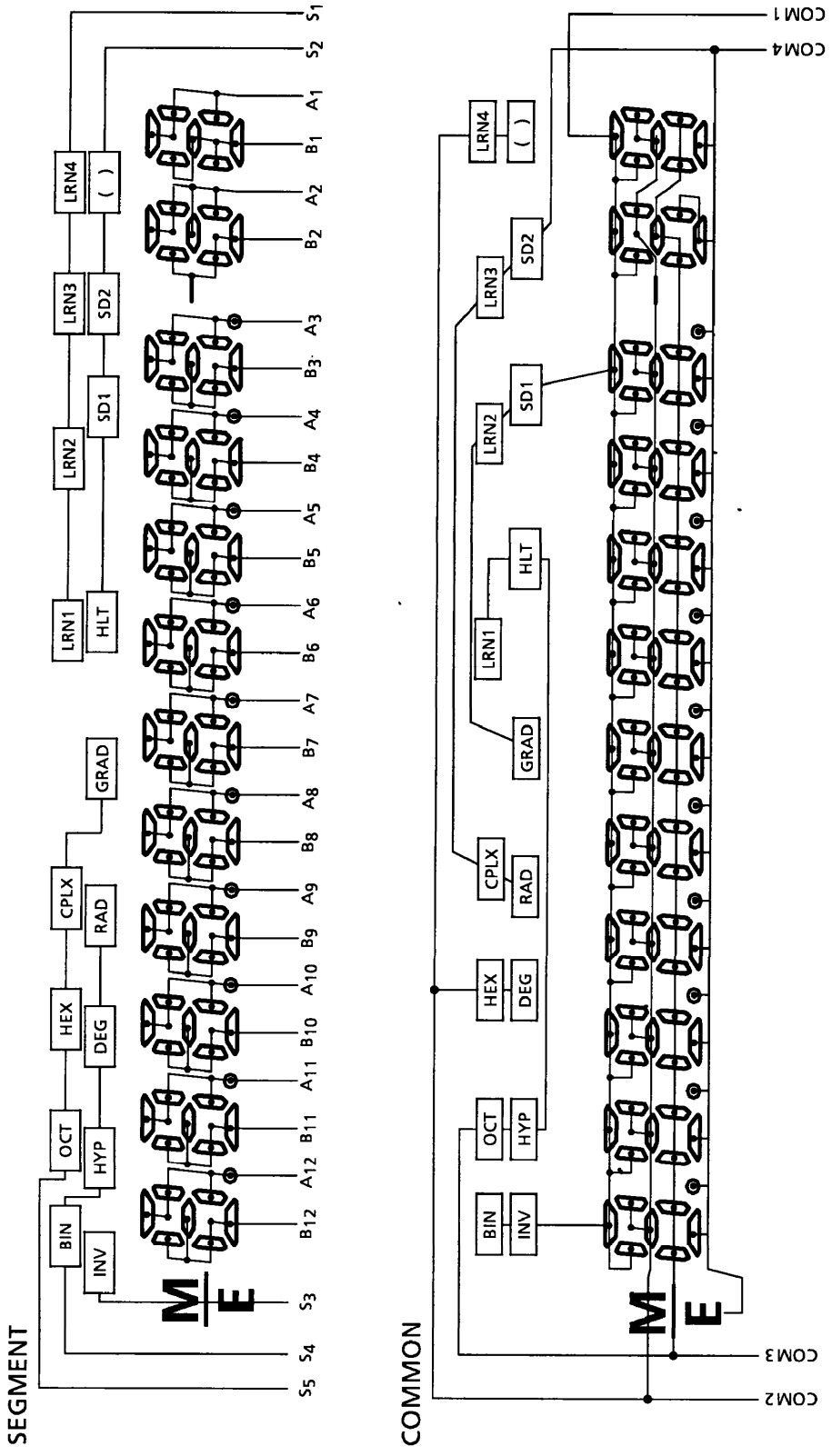
SYSTEM BLOCK DIAGRAM



(Note) Input capacity ≦ 400 (pF) at V_{SS} = − 3.0 (V)
Key resistance ≦ 5.0 (kΩ) at V_{SS} = − 3.0 (V)

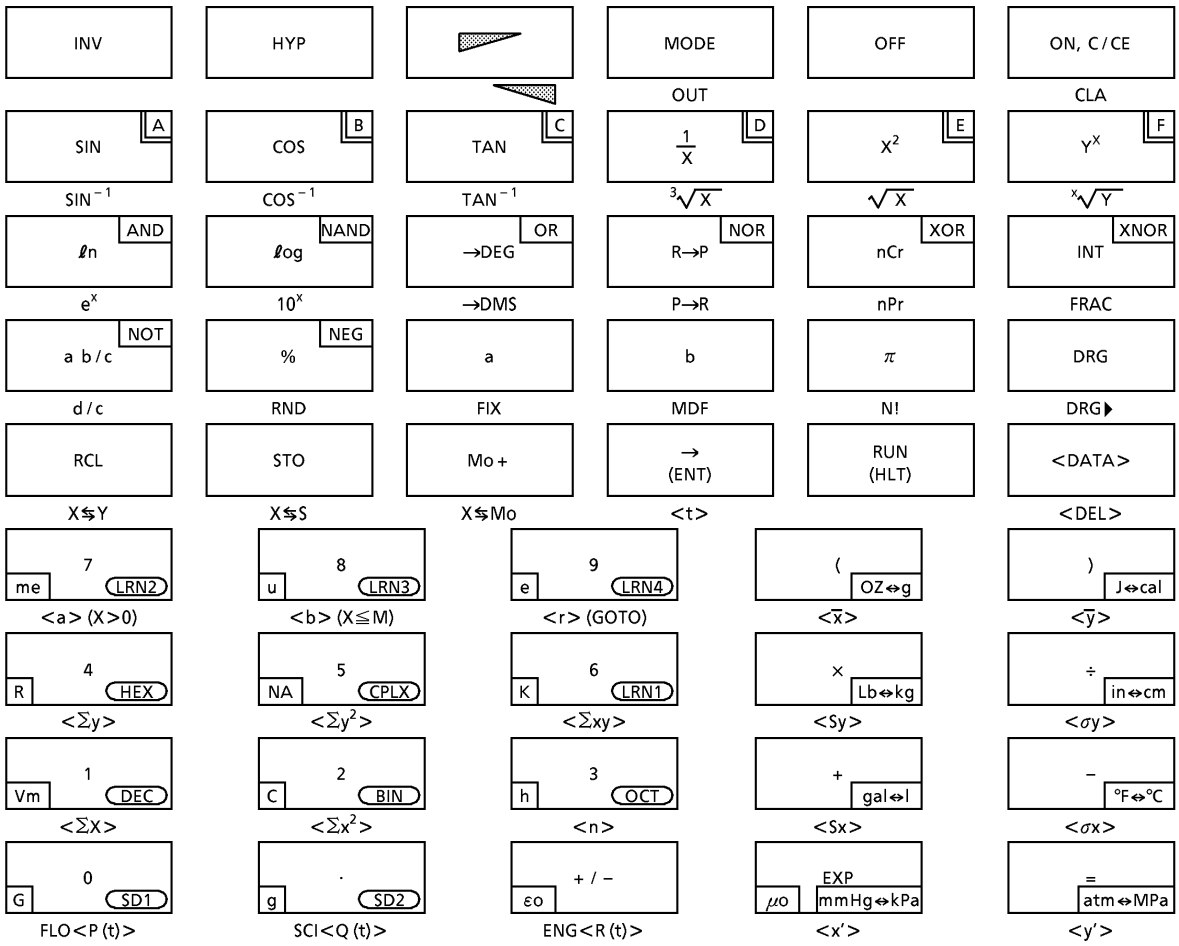
CONNECTION OF LCD



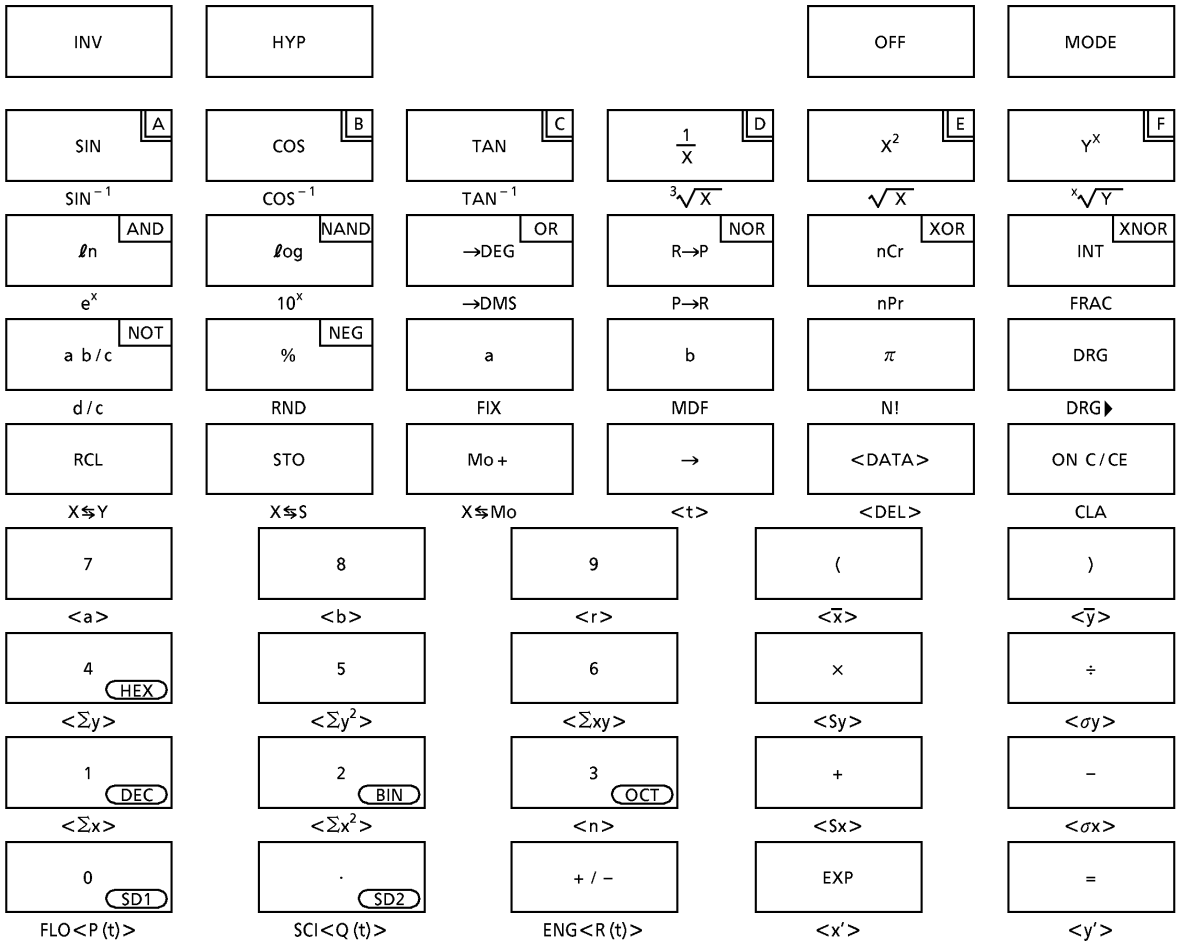
T7942S—04

SET KEY LAYOUT (Example)

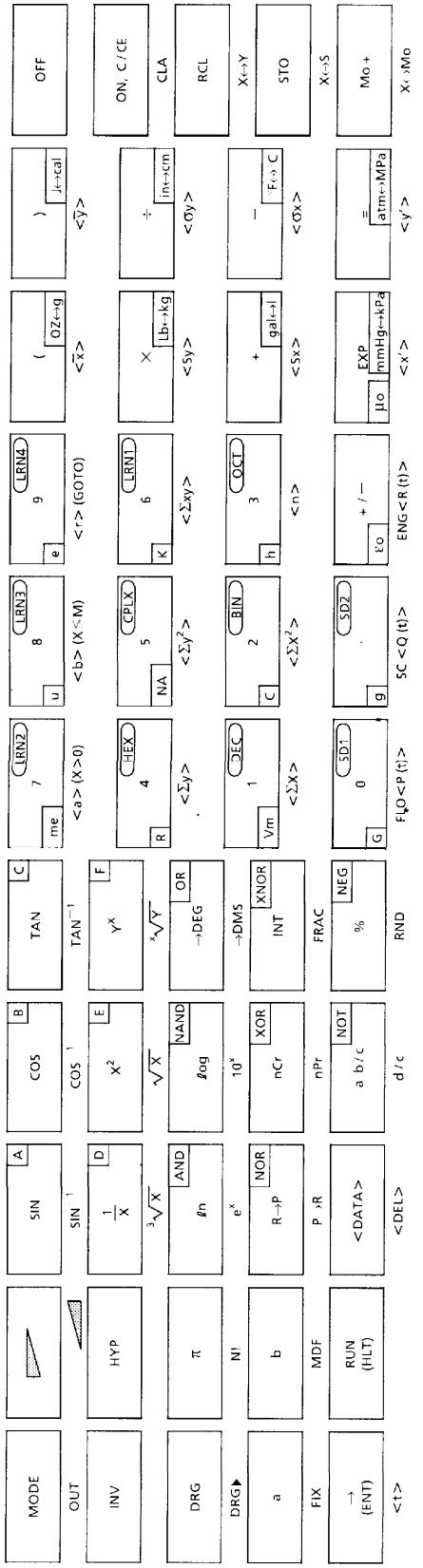
Used 50 touch Key with all function



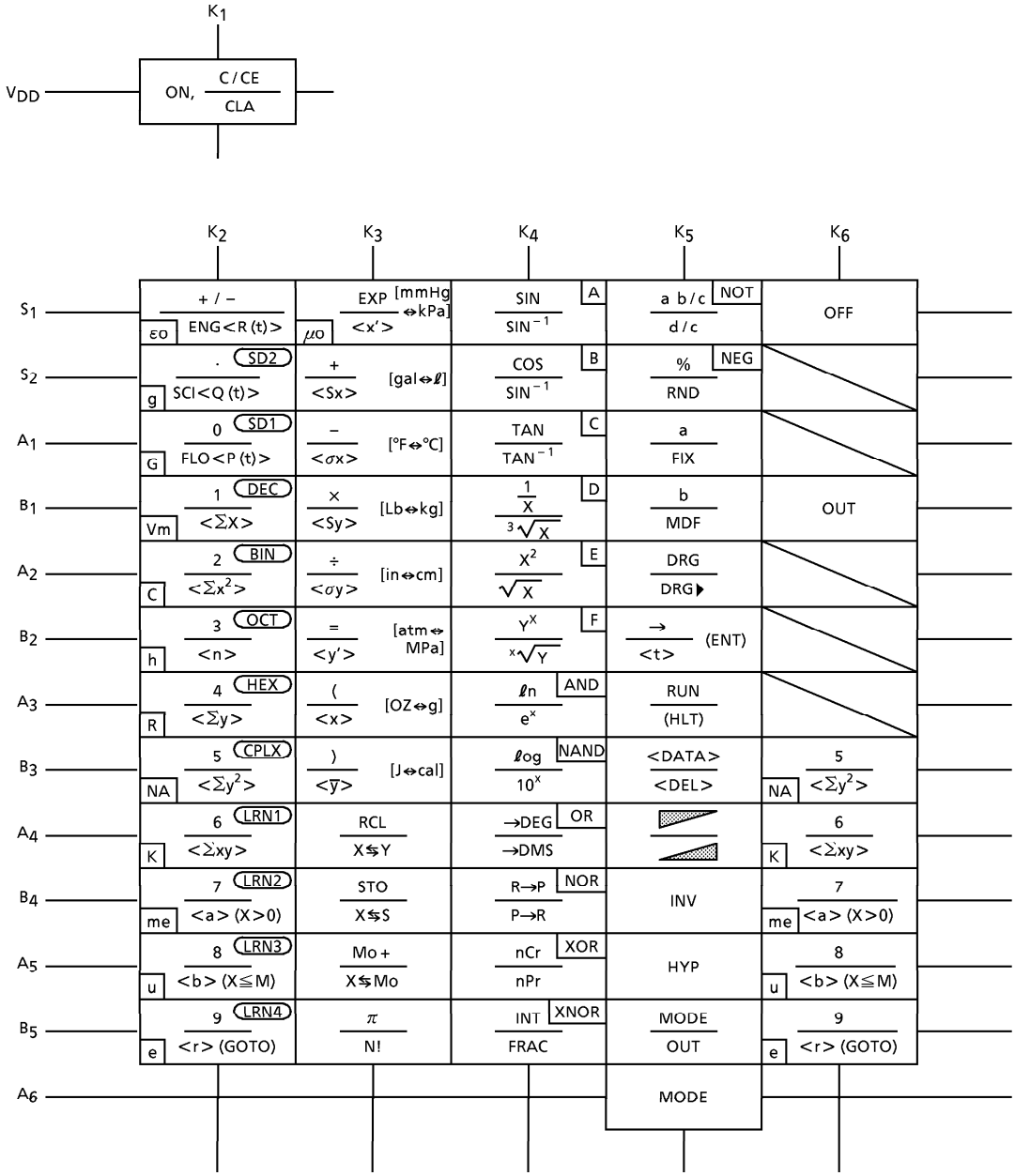
Used 48 tuch key without CPLX mode, LRN 1~4 mode, conversion, and scientific constant



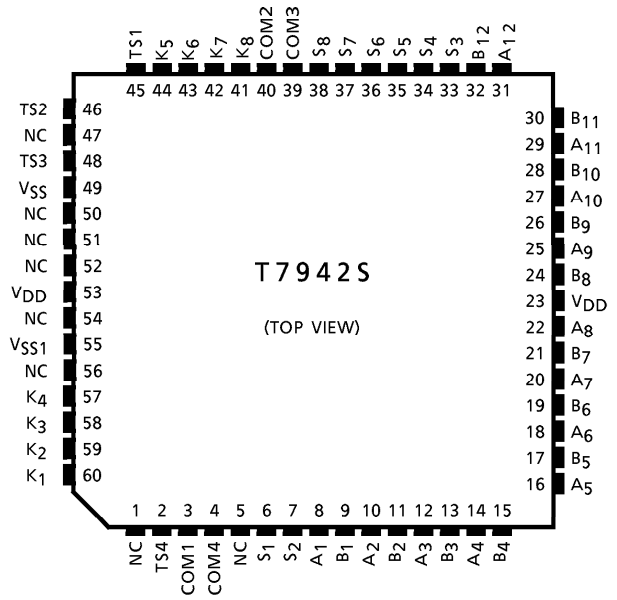
Used 50 touch key with all function



KEY CONNECTION



PIN ASSIGNMENT



SPECIFICATION OF CALCULATOR

Speed of calculation

Key on 5.3ms Key off 36.8ms $f\phi WAIT = 15kHz$, $f\phi op = 190kHz$

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	5
		A	A	5
Function	DEC	5	+	10
		5	×	11
	HEX	A	−	31
		A	÷	32
4 operation	DEC	1 + 2	+	14
		1 0 0 0 0 0 0 0 0 0 − 1	−	15
		5 × 9	×	15
		5 5 5 5 5 × 9 9 9 9 9	×	17
		5 ÷ 9	÷	22
		5 5 5 5 5 ÷ 9 9 9 9 9	÷	26
	HEX	A B C + D E F	+	45
		A B C − D E F	−	70
		A B C × D E F	×	49
		A B C ÷ D E F	÷	53
Y^X, $\sqrt[X]{Y}$		3 Y^X 4	=	110
		3 $\sqrt[X]{Y}$ 4	=	113

ITEM	OPERATION			CALCULATION SPEED (ms)
SIN	DEG	3 0	SIN	102
	RAD	π ÷ 6 =	SIN	98
	GRAD	1 0 0 ÷ 3 =	SIN	148
COS	DEG	6 0	COS	103
	RAD	π ÷ 3 =	COS	131
	GRAD	200 ÷ 3 =	COS	150
TAN	DEG	4 5	TAN	51
	RAD	π ÷ 4 =	TAN	20
	GRAD	5 0	TAN	22
SIN^{-1}	DEG	0. 5	SIN^{-1}	106
	RAD	0. 5	SIN^{-1}	84
	GRAD	0. 5	SIN^{-1}	105
COS^{-1}	DEG	0. 5	COS^{-1}	136
	RAD	0. 5	COS^{-1}	97
	GRAD	0. 5	COS^{-1}	134
TAN^{-1}	DEG	1	TAN^{-1}	32
	RAD	1	TAN^{-1}	21
	GRAD	1	TAN^{-1}	32
Ln		2 0	ln	24
Log		2 0	ℓog	46
e^x		2 0	e^x	44
10^x		1. 2 3	10^x	52
		1 0	10^x	22
X!		6 9	N!	129
HYP		3 hyp	SIN	80
		3 hyp	COS	81
		3 hyp	TAN	99
ARC HYP		3 hyp^{-1}	SIN	78
		3 hyp^{-1}	COS	87
		0.5 hyp^{-1}	TAN	75
X^2		2 0	X^2	11
$\sqrt{}$		2 0	$\sqrt{}$	30
1/X		2 0	1/X	13
$\sqrt[3]{}$		2 0	$\sqrt[3]{}$	80
→DEG		1.2 3 4 5	→DEG	37
→DMS		1.2 3 4 5	→DMS	41
→RAD	DEG	3 6 0	DRG▶	20
→GRAD	RAD	2 × π =	DRG▶	14
→DEG	GRAD	4 0 0	DRG▶	11
Random number		C / C E	RND	164
INT		1.2 3	INT	13
FRAC		1.2 3	FRAC	14

ITEM	OPERATION			CALCULATION SPEED (ms)
MDF	FIX2	1 ÷ 3 =	MDF	15
Exchange		1 2 3 + 4 5 6	X⇆Y	11
Shift		1 2 3	→	7
Fractions	Function	2 ab/c 3 6 ab/c 2 3 4	−	33
		2 ab/c 3 6 ab/c 2 3 4	÷	33
	4-operation	2 _ 36⌟ 234 + 3 _ 45 ⌟ 345	=	68
		2 _ 36⌟ 234 − 3 _ 45 ⌟ 345	=	65
		2 _ 36⌟ 234 × 3 _ 45 ⌟ 345	=	65
		2 _ 36⌟ 234 ÷ 3 _ 45 ⌟ 345	=	73
%		1 2 3 + 4 5 6	%	11
		1 2 3 − 4 5 6	%	11
		1 2 3 × 4 5 6	%	9
		1 2 3 ÷ 4 5 6	%	8
R→P	DEG	$\sqrt[3]{}$ a 1 b	R→P	117
	RAD	$\sqrt[3]{}$ a 1 b	R→P	92
	GRAD	$\sqrt[3]{}$ a 1 b	R→P	117
P→R	DEG	2 a 3 0 b	P→R	195
	RAD	2 a 30 DRG▶ b	P→R	185
	GRAD	2 a 30 DRG▶ DRG▶ b	P→R	264
Permutation combination		6 9 a 3 5 b	nPr	221
		7 0 a 3 0 b	nCr	218
Memory		1 2 3 STO 0	0	36
		1 2 3 STO 0	M+	40
		1 2 3 STO 0 RCL	0	8
		1 2 3 STO 0 X⇆S	0	37
		1 2 3 STO 0 4 5 6 STO +	0	38
		1 2 3 STO 0 4 5 6 STO −	0	38
		1 2 3 STO 0 4 5 6 STO ×	0	39
		1 2 3 STO 0 4 5 6 STO ÷	0	47
Mutual Conversion	DEC	1 2 3	→BIN	22
		1 2 3 4 5	→OCT	24
		1 2 3 4 5	→HEX	26
	BIN	1 0 1 0 1	→DEC	15
	OCT	1 2 3 4 5	→DEC	17
	HEX	A B C D E	→DEC	25
Logical operation	HEX	A B C AND D E F	=	99
		A B C NAND D E F	=	139
		A B C OR D E F	=	105
		A B C NOR D E F	=	132
		A B C XOR D E F	=	92
		A B C XNOR D E F	=	145
		A B C	NOT	55
NEG	HEX	A B C	NEG	54

ITEM	OPERATION				CALCULATION SPEED (ms)
Complex Calculation	ADD	(12 + 34 i) + (56 + 78 i)		=	13
	SUB	(12 + 34 i) − (56 + 78 i)		=	14
	MLT	(12 + 34 i) × (56 + 78 i)		=	23
	DIV	(12 + 34 i) ÷ (56 + 78 i)		=	47
Statistic calculation	1 a 1.1 b DATA 2 a 2.2 b DATA ~ 9 a 9.9 b			DATA	43
	The above-mentioned data			n	9
				X	13
				Y	14
				ΣX	8
				ΣY	9
				ΣX^2	9
				ΣY^2	9
				Sx	39
				Sy	41
				σx	45
				σy	46
				a	38
				b	33
				r	59
			5. 5	x′	39
			5. 5	y′	39
			5. 5	t	74
Normal distributions			1	P (t)	121
			1	Q (t)	120
			1	R (t)	118
Program operation	LRN1	continue	1	+	12
			2	+	16
			3	+	15
			4	+	15
			5	+	16
			6	+	16
			7	+	16
			8	+	15
			9	+	16
			10	=	14
	DEC	above program	RUN	LRN1	156

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 $\|X\| = (2n-1) \cdot 90$	SAME AS SIN X	
	RAD	SAME AS SIN X except $\|X\| = (2n-1) \cdot \pi / 2$	SAME AS SIN X	
	GRAD	SAME AS SIN X except $\|X\| = (2n-1) \cdot 100$	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 $SIN^{-1}X$	
SINH X		$0 \leqq \|X\| \leqq 230.2585092$	—	
COSH X		$0 \leqq \|X\| \leqq 230.2585092$	—	
TANH X		$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
$SINH^{-1}X$		$0 \leqq \|X\| \leqq 4.999999999 \times 10^{99}$	—	
$COSH^{-1}X$		$1 \leqq X \leqq 4.999999999 \times 10^{99}$	—	
$TANH^{-1}X$		$0 \leqq \|X\| \leqq 9.999999999 \times 10^{-1}$	—	
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)	—	
$\frac{1}{X}$		$1 \times 10^{-99} \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	$1.000000001 \times 10^{99} \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	

FUNCTION	OPERATION RANGE	UNDER FLOW AREA	NORMAL ACCURACY
X^2	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{49}$	$0 \leqq \|X\| \leqq 3.162277660 \times 10^{-50}$	±1 in 10th significant digit
$\sqrt{X}$	$0 \leqq X \leqq 9.999999999 \times 10^{99}$	—	
$\sqrt[3]{X}$	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
DMS→DEG	$0 \leqq \|X\| \leqq 9999999999.$	—	
DEG→DMS	$0 \leqq \|X\| \leqq 9999999.999$	$0 \leqq \|X\| \leqq 1.388888888 \times 10^{-6}$	±1 in least significant digit
DEG→RAD	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	$0 \leqq \|X\| \leqq 5.729577951 \times 10^{-98}$	±1 in 10th significant digit
RAD→GRAD	$0 \leqq \|X\| \leqq 1.570796326 \times 10^{98}$	—	
GRAD→DEG	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	$0 \leqq \|X\| \leqq 1.111111111 \times 10^{-99}$	
MDF	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
INT	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
FRAC	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	—	
Y^X	$-9.999999999 \times 10^{99} \leqq X \cdot LN \|Y\| \leqq 230.2585092$	$-9.999999999 \times 10^{99} \leqq X \cdot LN \|Y\| \leqq -227.9559243$	
	$Y>0$ … The above-mentioned operation range. $Y<0$ … X (Integer) or, 1/X (Odd, $X \neq 0$) … The above-mentioned operation range. $Y=0 \cdots 0<X$		
$\sqrt[X]{Y}$	$-9.999999999 \times 10^{99} \leqq \frac{1}{X} \cdot LN \|Y\| \leqq 230.2585092$	$-9.999999999 \times 10^{99} \leqq \frac{1}{X} \cdot LN \|Y\| \leqq -227.9559243$	
	$Y>0$ … The above-mentioned operation range. $Y<0$ … X (Odd) or, 1/X (Integer, $X \neq 0$) … The above-mentioned operation range. $Y=0 \cdots 0<X$		
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	
nPr	$0 \leqq n \leqq 99$, $r \leqq n$ n, r = Integer $1 \leqq (n!/(n-\gamma)!\} \leqq 9.999999999 \times 10^{99}$		
nCr	$0 \leqq n \leqq 99$ $r \leqq n$ n, r = Integer		

FUNCTION		OPERATION RANGE	NORMAL ACCURACY
Complex number calculation	$(x_1 + y_1\ i) \overset{+}{\underset{\div}{\underset{-}{\times}}} (x_2 + y_2\ i)$		±1 in 10th significant digit
	Addition Subtraction	$\lvert x_1 + x_2 \rvert \leqq 9.999999999 \times 10^{99}$ $\lvert y_1 + y_2 \rvert \leqq 9.999999999 \times 10^{99}$	
	Multiplication	$(x_1\ x_2 - y_1\ y_2) \leqq 9.999999999 \times 10^{99}$ $(y_1\ x_2 + x_1\ y_2) \leqq 9.999999999 \times 10^{99}$ $(x_1x_2),\ (y_1y_2),\ (y_1x_2),\ (x_1y_2) \leqq 9.999999999 \times 10^{99}$	
	Division	$\frac{x_1x_2 + y_1y_2}{x_2^2 + y_2^2},\ \frac{y_1x_2 - x_1y_2}{x_2^2 + y_2^2} \leqq 9.999999999 \times 10^{99}$ $x_2^2 + y_2^2,\ x_2^2,\ y_2^2,\ x_1x_2 + y_1y_2,\ y_1x_2 - x_1y_2,\ x_1x_2,\ y_1y_2,\ y_1x_2,\ x_1y_2,$ $\leqq 9.999999999 \times 10^{99}$	
→DEC		The following operation range after the conversion. $0 \leqq \lvert X \rvert \leqq 9999999999.$	—
→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. $FDABF41C01 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FF$	—
AND NAND OR NOR 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. $FDABF41C01 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FF$	—
NOT		BIN ; SAME AS AND OCT ; SAME AS AND HEX ; $FDABF41C01 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FE$	—
NEG		BIN ; $1000000001 \leqq X \leqq 1111111111$ $0 \leqq X \leqq\ 111111111$ OCT ; $4000000001 \leqq X \leqq 7777777777$ $0 \leqq X \leqq 3777777777$ HEX ; $FDABF41C01 \leqq X \leqq FFFFFFFFFF$ $0 \leqq X \leqq 2540BE3FF$	—

FUNCTION		OPERATION RANGE	NORMAL ACCURACY
NORMAL DISTRIBUTIONS·STATISTIC CALCULATION	DATA DEL	$\|x\| \leqq 9.999999999 \times 10^{49}$ $\|\Sigma x\| \leqq 9.999999999 \times 10^{99}$ $\Sigma x^2 \leqq 9.999999999 \times 10^{99}$ $0 \leqq n \leqq 9999999999.$ n = Integer	±1 in 10th significant digit
	$\bar{x}$	$n \neq 0$	
	$\bar{y}$	$n \neq 0$	
	Sx	$n \neq 1,\ n \neq 0$ $0 \leqq \frac{\Sigma X^2 - \{(\Sigma X)^2 / n\}}{n-1} \leqq 9.999999999 \times 10^{99}$	
	Sy	$n \neq 1,\ n \neq 0$ $0 \leqq \frac{\Sigma Y^2 - \{(\Sigma Y)^2 / n\}}{n-1} \leqq 9.999999999 \times 10^{99}$	
	σx	$n \neq 0$ $0 \leqq \frac{\Sigma X^2 - \{(\Sigma X)^2 / n\}}{n} \leqq 9.999999999 \times 10^{99}$	
	σy	$n \neq 0$ $0 \leqq \frac{\Sigma Y^2 - \{(\Sigma Y)^2 / n\}}{n} \leqq 9.999999999 \times 10^{99}$	
	t	$n \neq 0,\ \sigma x \neq 0$ $0 \leqq \left\| \frac{x - \bar{x}}{\sigma x} \right\| \leqq 9.999999999 \times 10^{99}$	
	P (t)	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	±1 in 6th significant digit
	Q (t)	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	
	R (t)	$0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$	

MAXIMUM RATINGS

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)

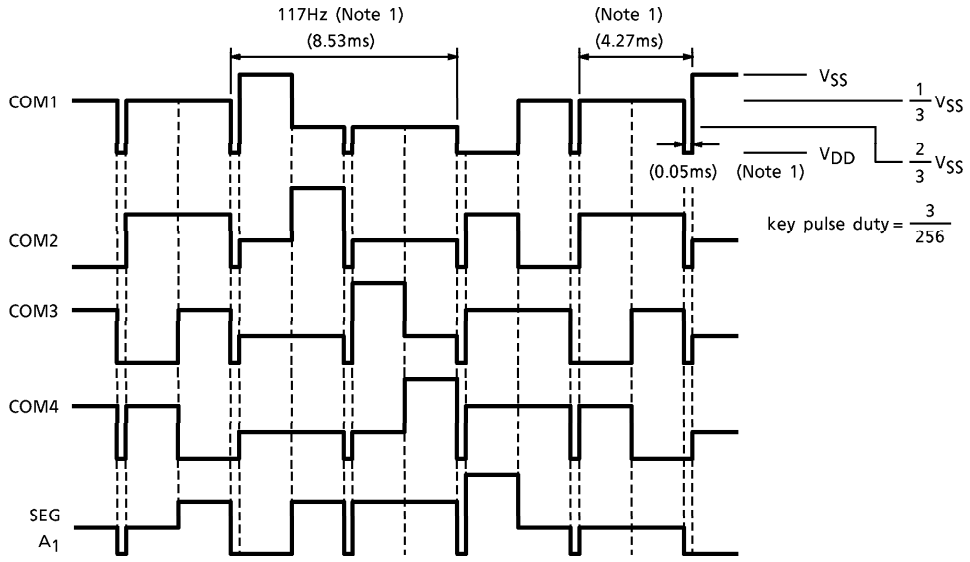
CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	—	—	—	—	−2.5	−3.0	−3.4	V
Supply Current (I)	I_{DD} WAIT	—	—	V_{SS} = −3.0V, wait	—	−18	−32	μA
Supply Current (II)	I_{DD} OP	—	—	V_{SS} = −3.0V, operate	—	−135	−200	
Supply Current (III)	I_{DD} OFF	—	—	V_{SS} = −3.0V, OFF	—	—	−2	
Oscillating Frequency (I)	Fϕ WAIT	—	—	V_{SS} = −3.0V, WAIT	9	15	21	kHz
Oscillating Frequency (II)	Fϕ OP	—	—	V_{SS} = −3.0V, operate	114	190	266	
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_8	—	$\frac{3}{4}V_{SS}$	—	V_{SS}	V
"0" Input Voltage	V_{IL}	—	K_1~K_8	—	V_{SS}	—	$\frac{1}{4}V_{SS}$	
"1" Output Resistance	R_{KEY}	—	SEG	V_{OUT} = V_{SS} + 0.5V : KEY STROBE	—	—	1	kΩ
"0" Output Resistance	R_{SEG} (L)	—	SEG	V_{OUT} = V_{DD} − 0.5V	—	—	90	
"1" Output Resistance	R_{SEG} (H)	—	SEG	V_{OUT} = V_{SS} + 0.5V : $\overline{\text{KEY STROBE}}$	—	—	90	
"0" Output Resistance	R_{COM} (L)	—	COM	V_{OUT} = V_{DD} − 0.5V	—	—	25	
"1" Output Resistance	R_{COM} (H)	—	COM	V_{OUT} = V_{SS} + 0.5V	—	—	25	
KEY PULL UP Resistance	$R_{PULL\ UP}$	—	K_1	V_{OUT} = 0V (Note 1)	28.8	48	67.2	
KEY PULL DOWN Resistance	$R_{PULL\ DOWN}$	—	K_2~K_8	V_{OUT} = V_{SS} (Note 1)	28.8	48	67.2	
"M" Output Resistance	R_{OM}	—	SEG	$V_{OUT} = \frac{2}{3}V_{SS} + 0.5V$	—	90	—	
"M" Output Resistance	R_{OM}	—	SEG	$V_{OUT} = \frac{2}{3}V_{SS} + 0.5V$	—	90	—	
"M" Output Resistance	R_{OM}	—	COM	$V_{OUT} = \frac{1}{3}V_{SS} - 0.5V$	—	90	—	
"M" Output Resistance	R_{OM}	—	COM	$V_{OUT} = \frac{2}{3}V_{SS} + 0.5V$	—	90	—	
"1" Output Voltage	V_{OH}	—	K_1	(Note 1)	V_{SS} + 0.2	V_{SS}	V_{SS}	

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
"0" Output Voltage	V_{OL}	—	K_2~K_8	(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}	
"M" Output Voltage	V_{OM}	—	SEG COM	—	$\frac{2}{3}V_{SS}$ + 0.2	$\frac{2}{3}V_{SS}$	$\frac{2}{3}V_{SS}$ − 0.2	
"M" Output Voltage	V_{OM}	—	SEG COM	—	$\frac{1}{3}V_{SS}$ + 0.2	$\frac{1}{3}V_{SS}$	$\frac{1}{3}V_{SS}$ − 0.2	
"0" Output Voltage	V_{OL}	—	SEG COM	—	V_{DD}	V_{DD}	V_{DD} − 0.2	

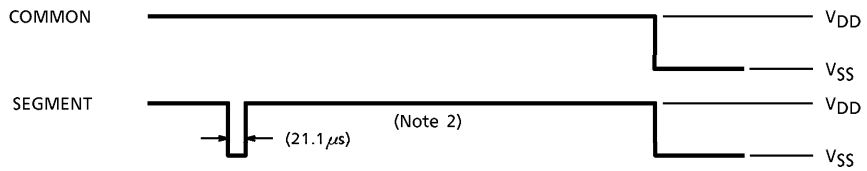
(Note 1) The key buffer is high impedance at $\overline{\text{keystrobe}}$.

WAVEFORMS FOR DISPLAY

Display



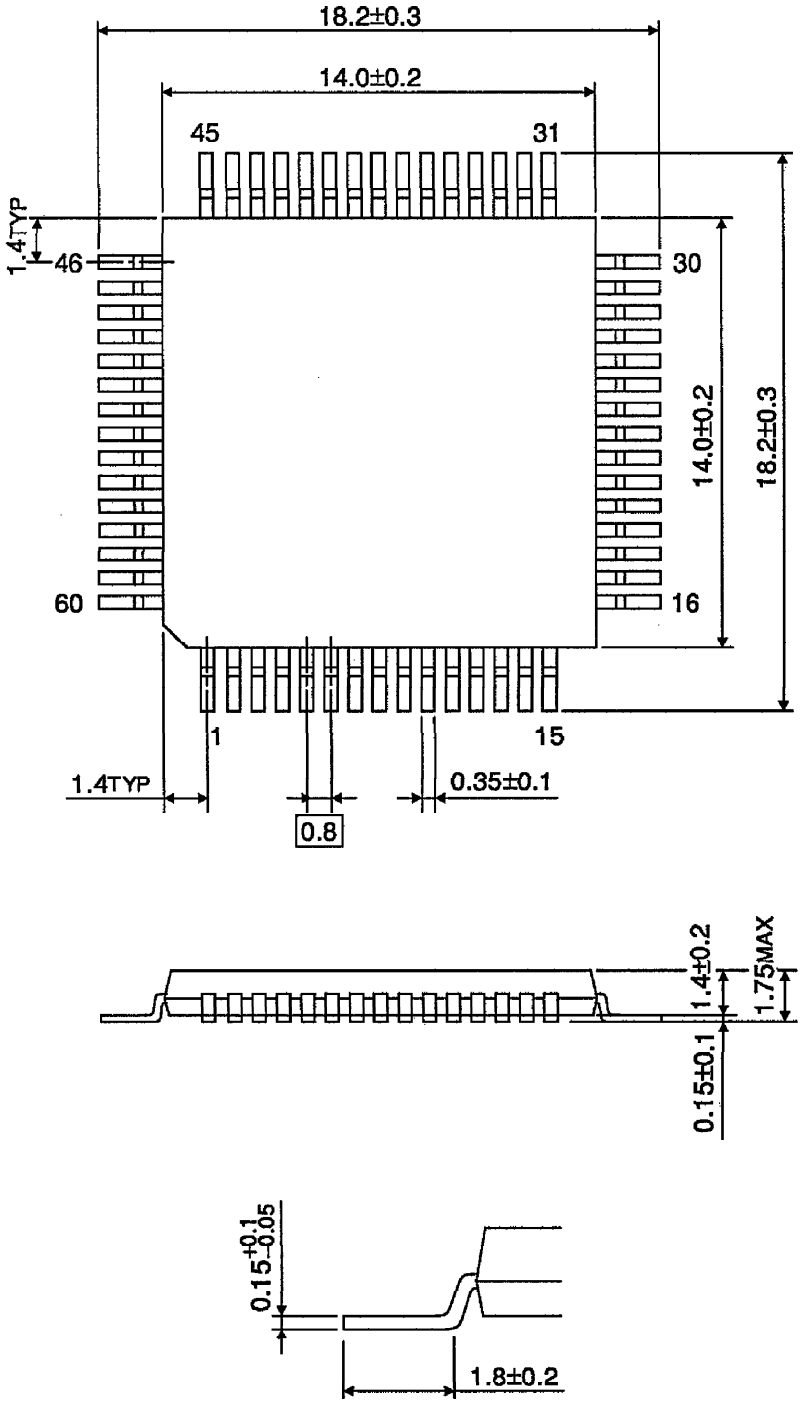
Key pulse output



(Note 1) $F\phi WAIT = 15kHz$
(Note 2) $F\phi OP = 190kHz$

PACKAGE DIMENSIONS

LQFP60-P-1414-0.80 Unit : mm



Weight : 0.66g (Typ.)