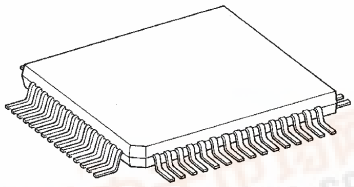
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# T7942S

## T7942S CMOS 1 CHIP LSI FOR LCD ELECTRONIC CALCULATOR

The T7942S is a 1 chip microcomputer for 10-digits + 2-digits electronic scientific caluculation.
T7942S is the complete single chip CMOS LSI for electronic programmable scientific calculator with 10 digit, 129 function, 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

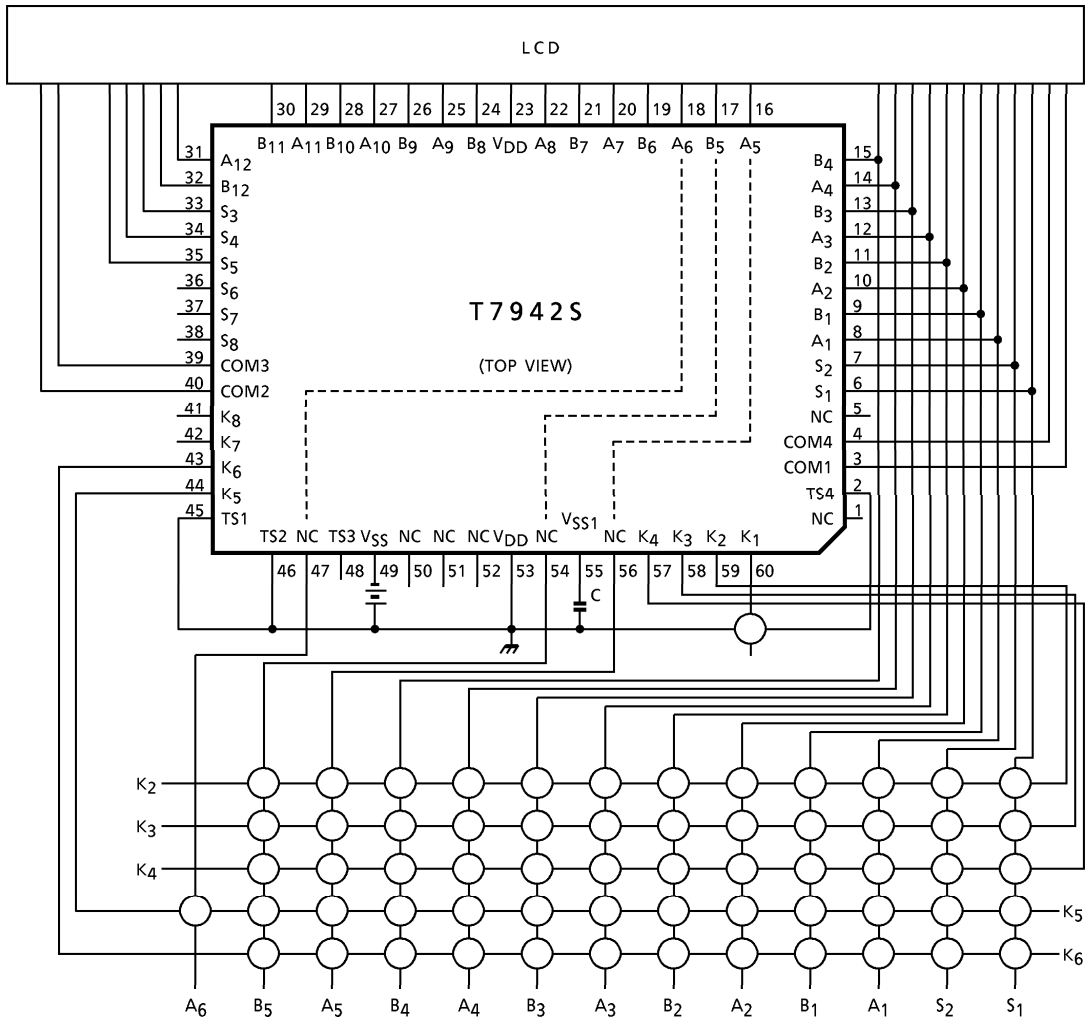
- Display 12 display digits plus 2 digits code at the right margin.
  - Scientific and engineering display.
    Mantissa 10 digits plus exponent 2 digits plus negative code 2 digits.
  - Other than above
    Mantissa 10 digits plus negative code 1 digit.
- 20 kinds of special display

| | | | |
|---|---|---|---|
| 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.

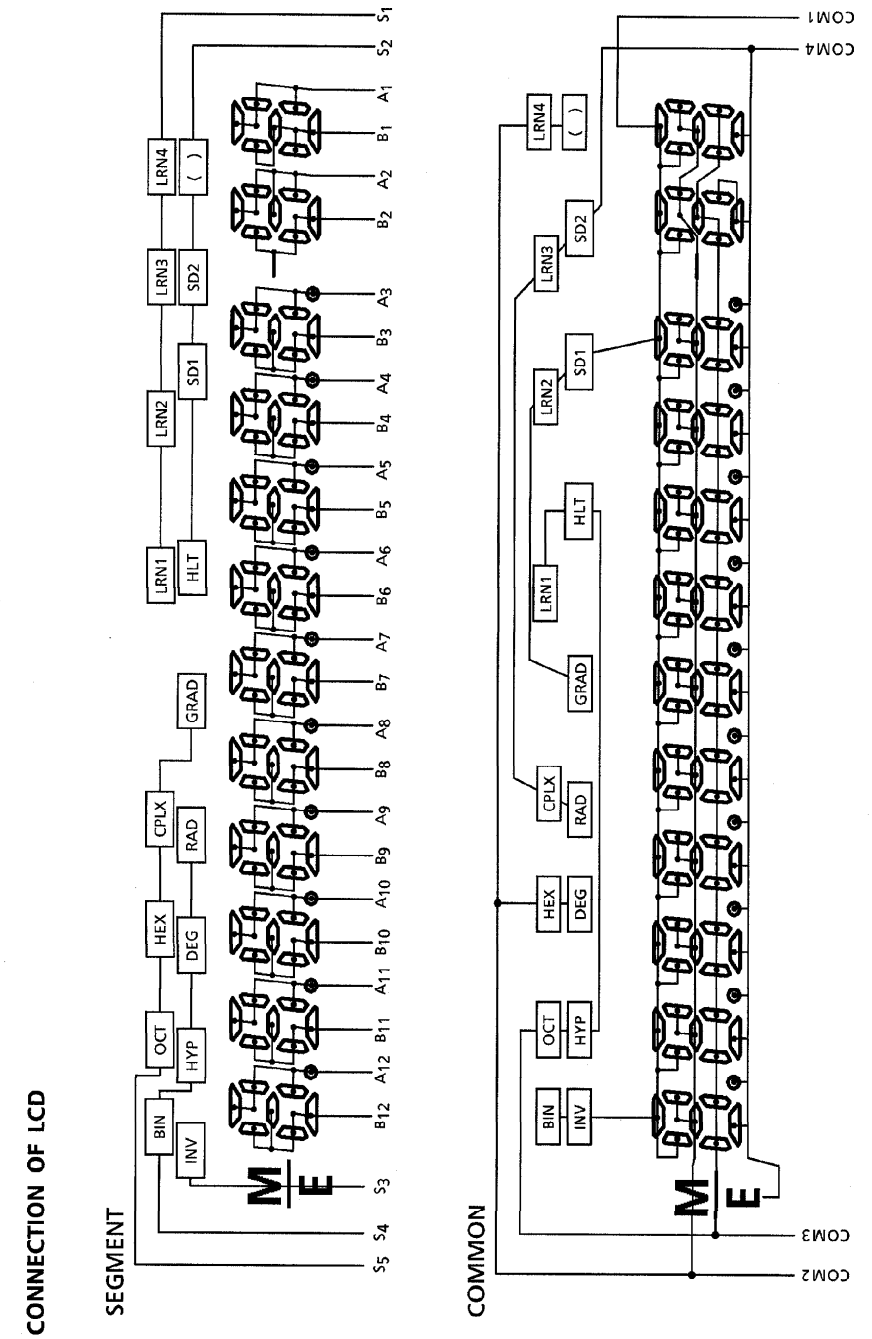
- Mutual conversion between decimal, binary, octal and hexadecimal, and the 4 operations in arithmetic in binary, octal and hexadecimal are possible.
- Program function
  4 formula (LRN1~LRN4) total 128 steps.
  X>0, X≦M and GO TO judge function (It is possible to jump after and back within 9 steps).
  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.

## 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

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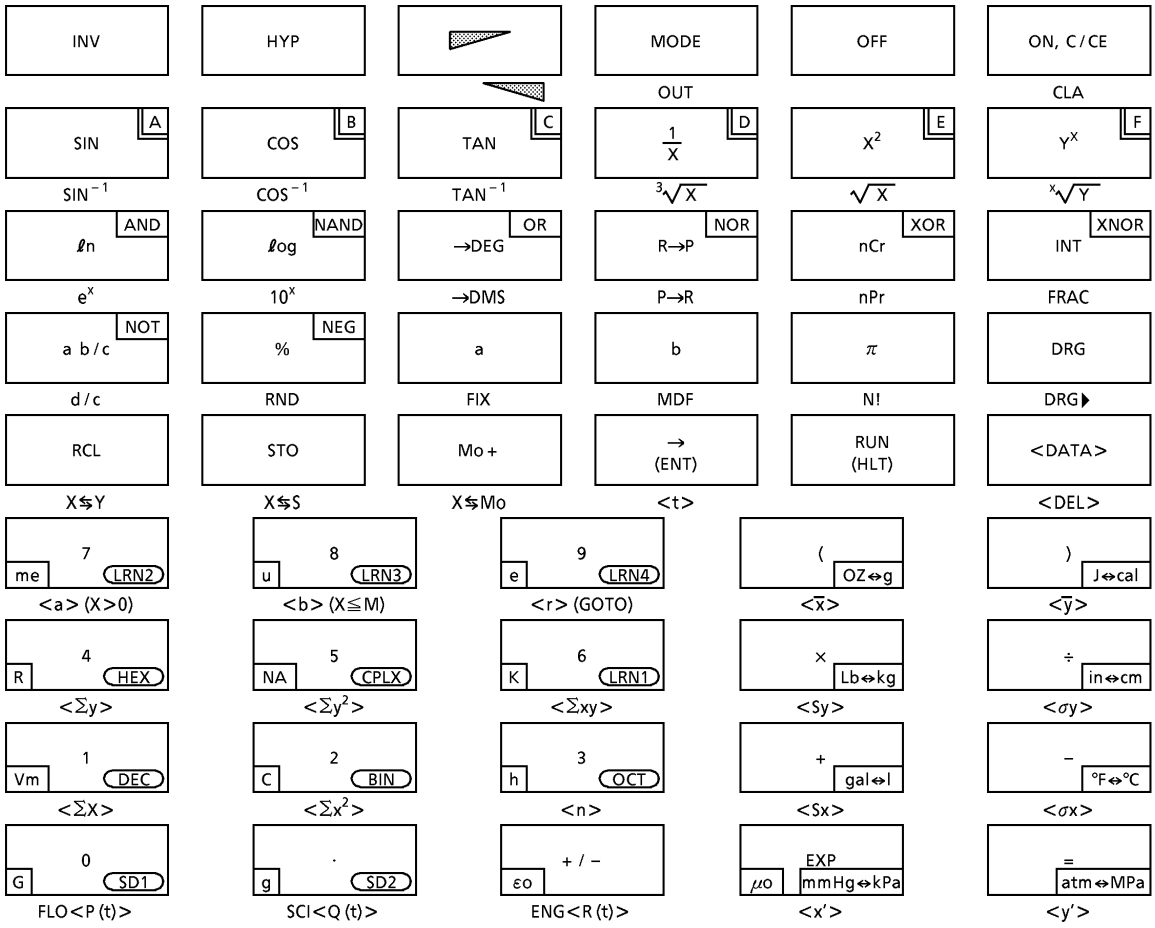
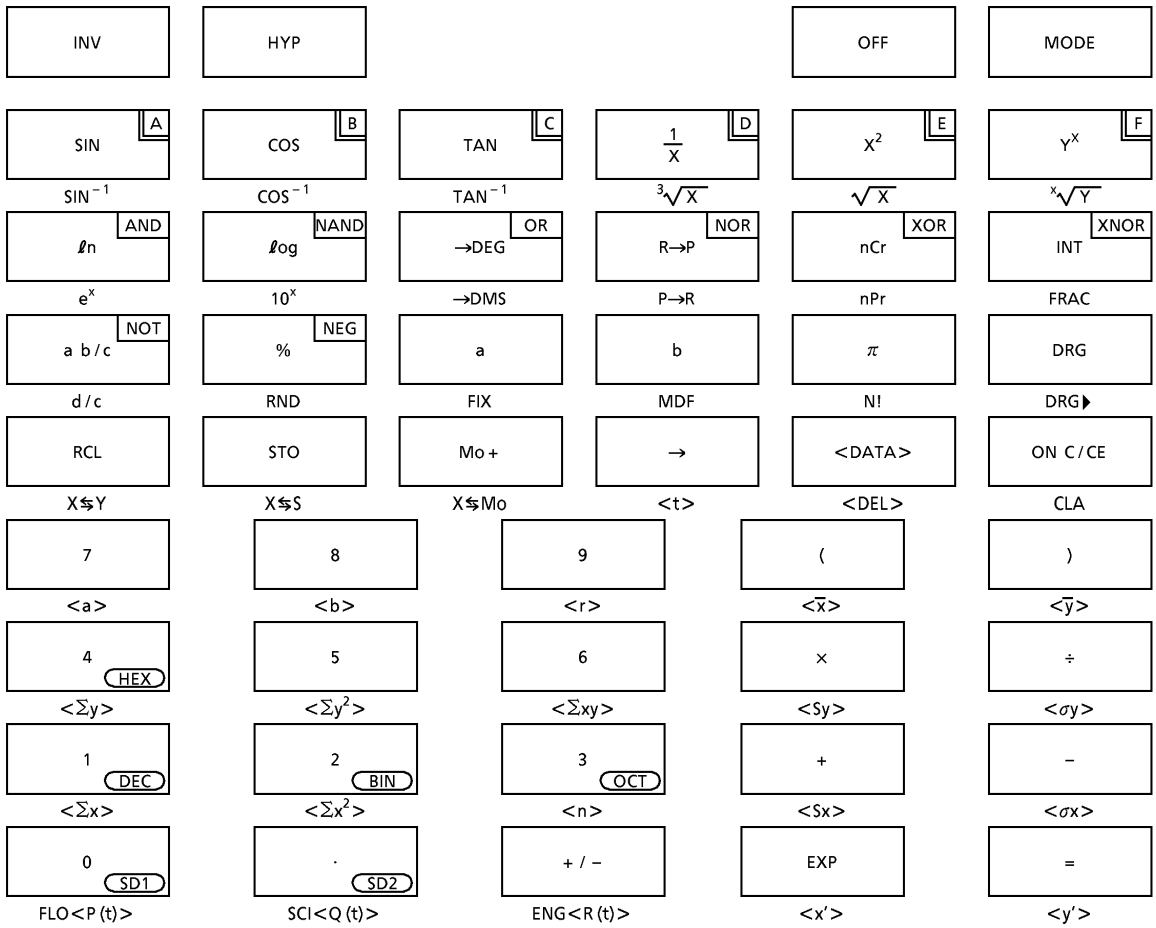
**SET KEY LAYOUT** (Example)

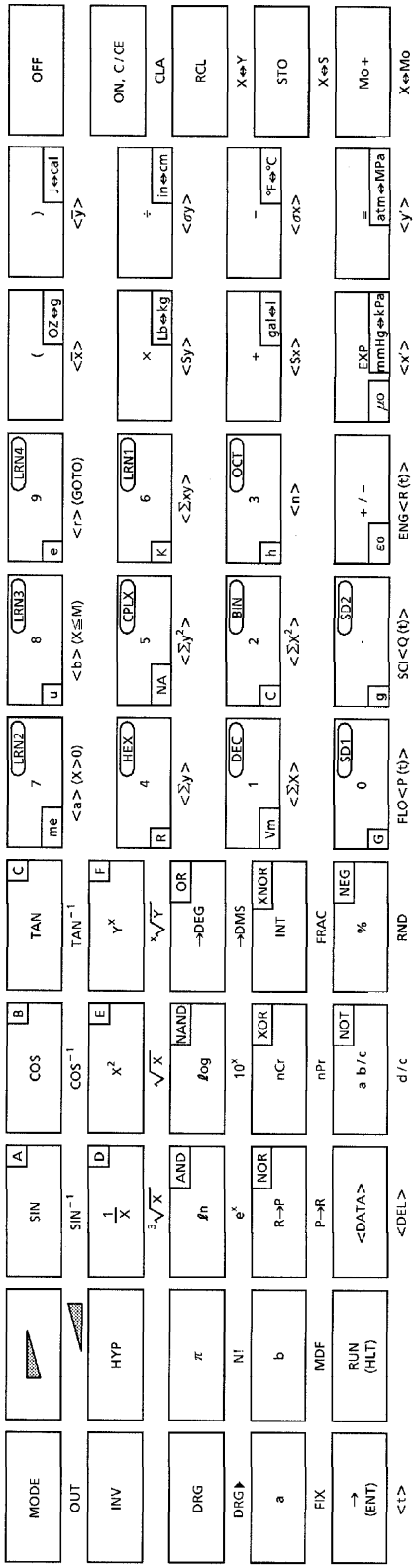
Used 50 touch Key with all function



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



Used 50 touch key with all function

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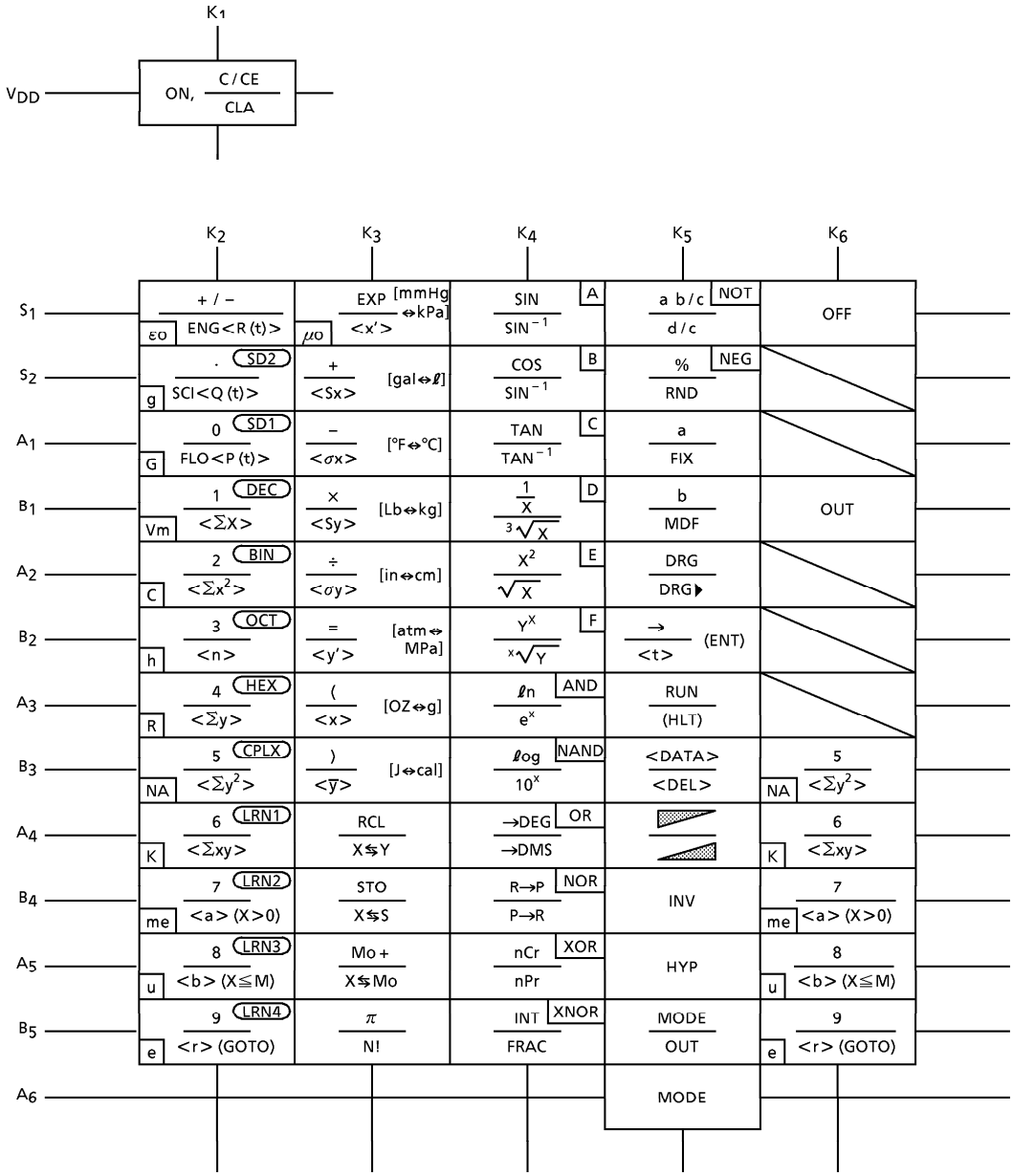
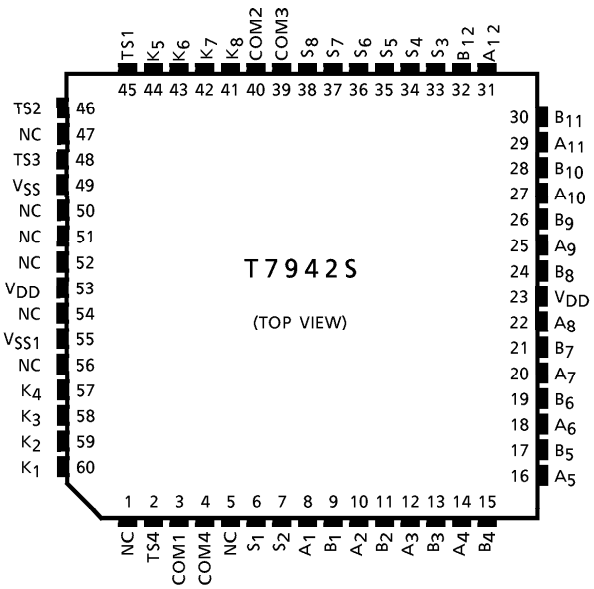
## KEY LAYOUT


K1
VDD
ON, C/CE CLA
K2
K3
K4
K5
K6
S1
S2
A1
B1
A2
B2
A3
B3
A4
B4
A5
B5
A6
+ / −
εo ENG<R(t)>
EXP [mmHg⇔kPa]
μo <x'>
SIN A
SIN⁻¹
a b/c NOT
d/c
OFF
. SD2
g SCI<Q(t)>
+
<Sx>
[gal⇔ℓ]
COS B
SIN⁻¹
% NEG
RND
0 SD1
G FLO<P(t)>
−
<σx>
[°F⇔°C]
TAN C
TAN⁻¹
a
FIX
1 DEC
Vm <ΣX>
×
<Sy>
[Lb⇔kg]
1/X D
³√X
b
MDF
OUT
2 BIN
C <Σx²>
÷
<σy>
[in⇔cm]
X² E
√X
DRG
DRG▶
3 OCT
h <n>
=
<y'>
[atm⇔MPa]
Y^X F
ˣ√Y
→
<t>
(ENT)
4 HEX
R <Σy>
(
<x>
[OZ⇔g]
ℓn AND
e^x
RUN
(HLT)
5 CPLX
NA <Σy²>
)
<ȳ>
[J⇔cal]
ℓog NAND
10^x
<DATA>
<DEL>
5
NA <Σy²>
6 LRN1
K <Σxy>
RCL
X⇆Y
→DEG OR
→DMS
6
K <Σxy>
7 LRN2
me <a> (X>0)
STO
X⇆S
R→P NOR
P→R
INV
7
me <a> (X>0)
8 LRN3
u <b> (X≦M)
Mo+
X⇆Mo
nCr XOR
nPr
HYP
8
u <b> (X≦M)
9 LRN4
e <r> (GOTO)
π
N!
INT XNOR
FRAC
MODE
OUT
9
e <r> (GOTO)
MODE

**PIN LAYOUT**




**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 | M0+ | 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. |
| | | | | $\Sigma X$ | 8. |
| | | | | $\Sigma Y$ | 9. |
| | | | | $\Sigma X^2$ | 9. |
| | | | | $\Sigma Y^2$ | 9. |
| | | | | Sx | 39. |
| | | | | Sy | 41. |
| | | | | $\sigma x$ | 45. |
| | | | | $\sigma y$ | 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 | $0 \leqq \|X\| \leqq 4.499999999 \times 10^{10}$ | $0 \leqq \|X\| \leqq 5.729577951 \times 10^{-98}$ | 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 $\|X\| = (2n-1) \cdot 90$ | 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 $SIN^{-1}X$ | |

| 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 | $0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$ | — | |
| $SINH^{-1}X$ | $0 \leqq \|X\| \leqq 4.999999999 \times 10^{99}$ | — | |
| $COSH^{-1}X$ | $1 \leqq X \leqq 4.999999999 \times 10^{99}$ | — | |
| $TANH^{-1}X$ | $0 \leqq \|X\| \leqq 9.999999999 \times 10^{-1}$ | — | |
| 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 |
|---|---|---|---|
| $X^2$ | $0 \leqq \|X\| \leqq 9.999999999 \times 10^{49}$ | $0 \leqq \|X\| \leqq 3.162277660 \times 10^{-50}$ | 10 digits ± 1 |
| $\sqrt{X}$ | $0 \leqq X \leqq 9.999999999 \times 10^{99}$ | — | |
| $\sqrt[3]{X}$ | $0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$ | — | |
| DMS→DEG | $0 \leqq \|X\| \leqq 9999999999.$ | — | |
| DEG→DMS | $0 \leqq \|X\| \leqq 9999999.999$ | $0 \leqq \|X\| \leqq 1.388888888 \times 10^{-6}$ | lowest digits ± 1 |
| DEG→RAD | $0 \leqq \|X\| \leqq 9.999999999 \times 10^{99}$ | $0 \leqq \|X\| \leqq 5.729577951 \times 10^{-98}$ | 10 digits ± 1 |
| 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.<br>$Y<0$ ··· X (Integer) or, 1 / X (Odd, $X \neq 0$)<br>··· The above-mentioned operation range.<br>$Y=0$ ··· $0<X$ | | |
| $\sqrt[X]{Y}$ | $-9.999999999 \times 10^{99} \leqq \frac{1}{X} \cdot LN \|Y\| \leqq 230.2585092$ | $-9.999999999 \times 10^{99} \leqq \frac{1}{X} \cdot LN \|Y\| \leqq -227.9559243$ | |
| | $Y>0$ ··· The above-mentioned operation range.<br>$Y<0$ ··· X (Odd) or, 1 / X (Integer, $X \neq 0$)<br>··· The above-mentioned operation range.<br>$Y=0$ ··· $0<X$ | | |
| R→P<br>$(xy \rightarrow \gamma\theta)$ | $x, y \leqq 9.999999999 \times 10^{49}$<br>$(x^2+y^2) \leqq 9.999999999 \times 10^{99}$<br>$\frac{y}{x}$ ; SAME AS $TAN^{-1}X$ | $\frac{y}{x}$ ; SAME AS $TAN^{-1}X$ | |
| P→R<br>$(\gamma\theta \rightarrow xy)$ | $0 \leqq \gamma \leqq 9.999999999 \times 10^{99}$<br>$\theta$ ; SAME AS SIN X, COS X | $\theta$ ; SAME AS SIN X, COS X | |
| nPr | $0 \leqq n \leqq 99$, $r \leqq n$ n, r = Integer<br>$1 \leqq (n! / (n-\gamma)!\} \leqq 9.999999999 \times 10^{99}$ | | |
| nCr | $0 \leqq n \leqq 99$ $r \leqq n$ n, r = Integer | | |

| FUNCTION | | OPERATION RANGE | NORMAL ACCURACY |
|---|---|---|---|
| Complex number calculation | $(x_1 + y_1\ i) \begin{matrix}+\\-\\\times\\\div\end{matrix} (x_2 + y_2\ i)$ | | 10 digits ±1 |
| | Addition<br>Subtraction | $\lvert x_1 + x_2\rvert \leqq 9.999999999 \times 10^{99}$<br>$\lvert y_1 + y_2\rvert \leqq 9.999999999 \times 10^{99}$ | |
| | Multiplication | $(x_1\ x_2 - y_1\ y_2) \leqq 9.999999999 \times 10^{99}$<br>$(y_1\ x_2 + x_1\ y_2) \leqq 9.999999999 \times 10^{99}$<br>$(x_1x_2),\ (y_1y_2),\ (y_1x_2),\ (x_1y_2) \leqq 9.999999999 \times 10^{99}$ | |
| | Division | $\frac{x_1x_2 + y_1y_2}{x_2^2 + y_2^2},\ \frac{y_1x_2 - x_1y_2}{x_2^2 + y_2^2} \leqq 9.999999999 \times 10^{99}$<br>$x_2^2 + y_2^2,\ x_2^2,\ y_2^2,\ x_1x_2 + y_1y_2,\ y_1x_2 - x_1y_2,\ x_1x_2,\ y_1y_2,\ y_1x_2,\ x_1y_2,$<br>$\leqq 9.999999999 \times 10^{99}$ | |
| →DEC | | The following operation range after the conversion.<br>$0 \leqq \lvert X\rvert \leqq 9999999999.$ | — |
| →BIN | | The following operation range after the conversion.<br>$1000000000 \leqq X \leqq 1111111111$<br>$0 \leqq X \leqq\ 111111111$ | — |
| →OCT | | The following operation range after the conversion.<br>$4000000000 \leqq X \leqq 7777777777$<br>$0 \leqq X \leqq 3777777777$ | — |
| →HEX | | The following operation range after the conversion.<br>$FDABF41C01 \leqq X \leqq FFFFFFFFFF$<br>$0 \leqq X \leqq 2540BE3FF$ | — |
| AND<br>NAND<br>OR<br>NOR<br>XOR<br>XNOR | | BIN ; $1000000000 \leqq X \leqq 1111111111$<br>$0 \leqq X \leqq\ 111111111$<br>OCT ; $4000000000 \leqq X \leqq 7777777777$<br>$0 \leqq X \leqq 3777777777$<br>HEX ; The following operation range after the operation.<br>$FDABF41C01 \leqq X \leqq FFFFFFFFFF$<br>$0 \leqq X \leqq 2540BE3FF$ | — |
| NOT | | BIN ; SAME AS AND<br>OCT ; SAME AS AND<br>HEX ; $FDABF41C01 \leqq X \leqq FFFFFFFFFF$<br>$0 \leqq X \leqq 2540BE3FE$ | — |
| NEG | | BIN ; $1000000001 \leqq X \leqq 1111111111$<br>$0 \leqq X \leqq\ 111111111$<br>OCT ; $4000000001 \leqq X \leqq 7777777777$<br>$0 \leqq X \leqq 3777777777$<br>HEX ; $FDABF41C01 \leqq X \leqq FFFFFFFFFF$<br>$0 \leqq X \leqq 2540BE3FF$ | — |

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

**MAXIMUM RATINGS**

| 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) | $I_{DD}$ 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 | $V_{SS}$ | $V_{SS}$ | |

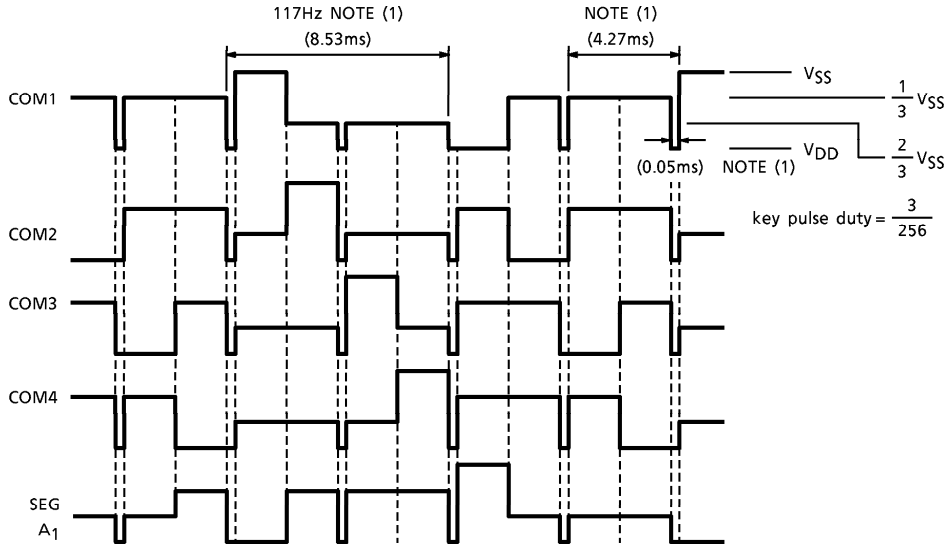
**ELECTRICAL CHARACTERISTICS** ($V_{DD}$ = −3.0 ± 0.2V, $V_{SS}$ = 0V, Ta = 25 ± 1.5°C)

| PARAMETER | 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 | |

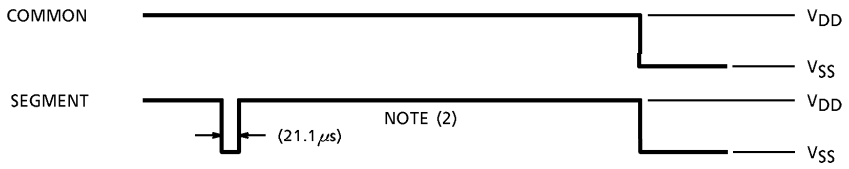
(Note 1) The key buffer is high impedance at $\overline{\text{keystrobe}}$.

**WAVEFORMS FOR DISPLAY**

Display



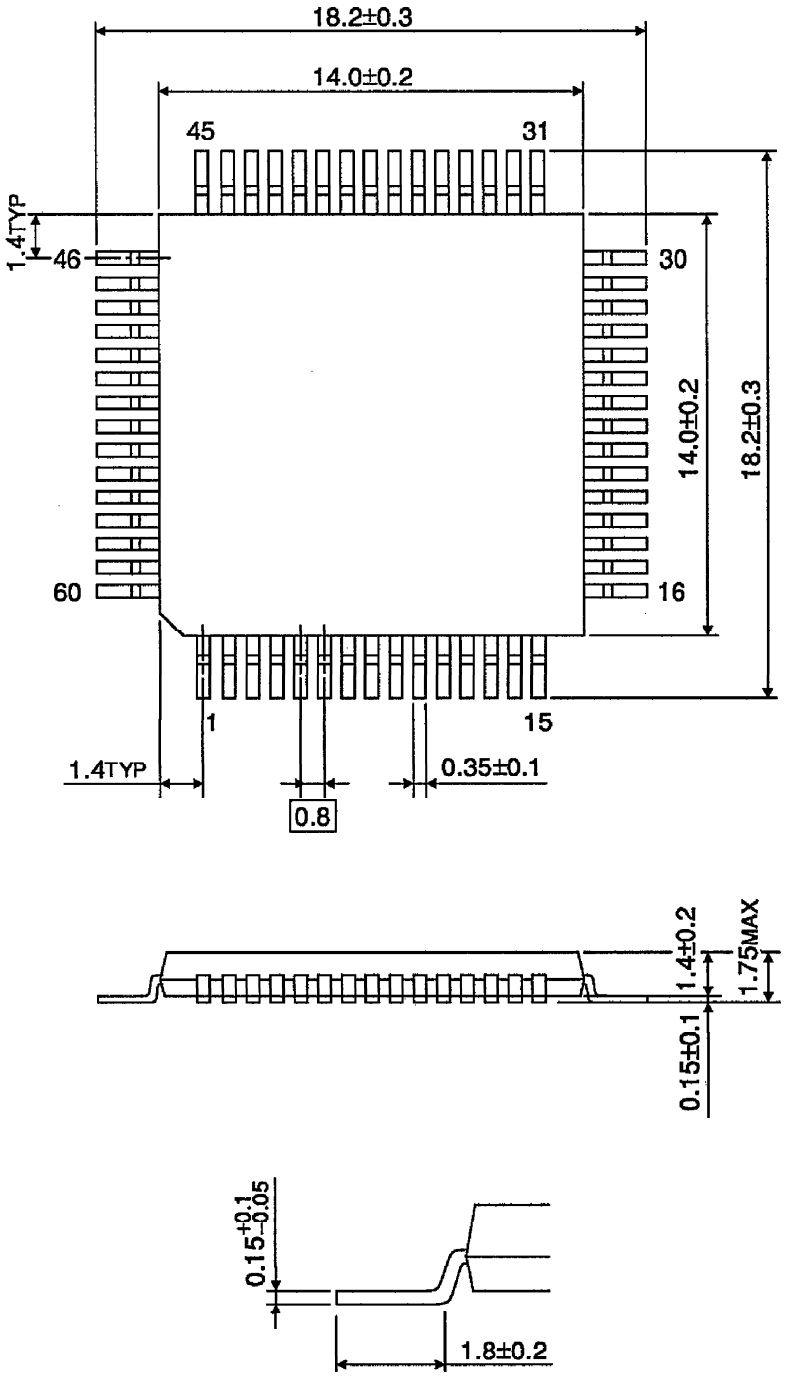

Key pulse output




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

**OUTLINE DRAWING**

LQFP60-P-1414-0.80 Unit : mm




Weight : 0.66g (Typ.)