

T6M27S

T6M27S SINGLE-CHIP CMOS LSI FOR LCD CALCULATORS

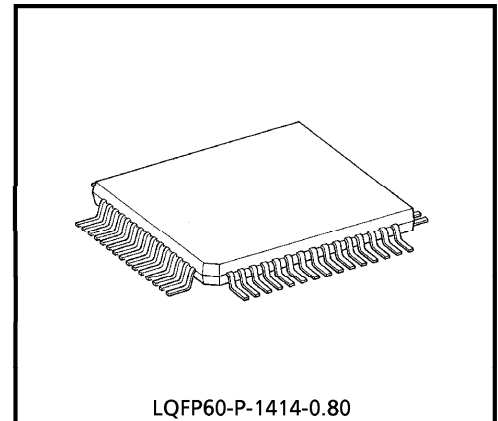
The T6M27S is single-chip microcomputer for 8-digit + 1-digit scientific calculation.

T6M27S is the complete single chip CMOS LSI for calculator with 8 digits, 27 functions, and fractional number calculation with the following features.

FEATURES

- 8-digit display plus 1-digit code at the right margin.
 - Scientific display.
 - Mantissa 6 digits plus exponent 2 digits plus negative code 2 digits.
 - Fractional number display.
 - 9 digits plus negative code 1 digit.
 - Other than above
 - Mantissa 8 digits plus negative code 1 digit.
- 9 kinds of special display

M	Memory	DEG	Degree
-	Minus	RAD	Radian
E	Error	GRAD	Gradian
INV	Inverse	()	Parenthesis calculation
- The minus sign of the mantissa is floating minus.
- The arithmetic key operation in clouding Y^x has same sequence as mathematical equation. 4 pending operations are allowed and () are up to continuous 15 levels.
- Fractional number calculation.
- One independent accumulating memory.
- 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.

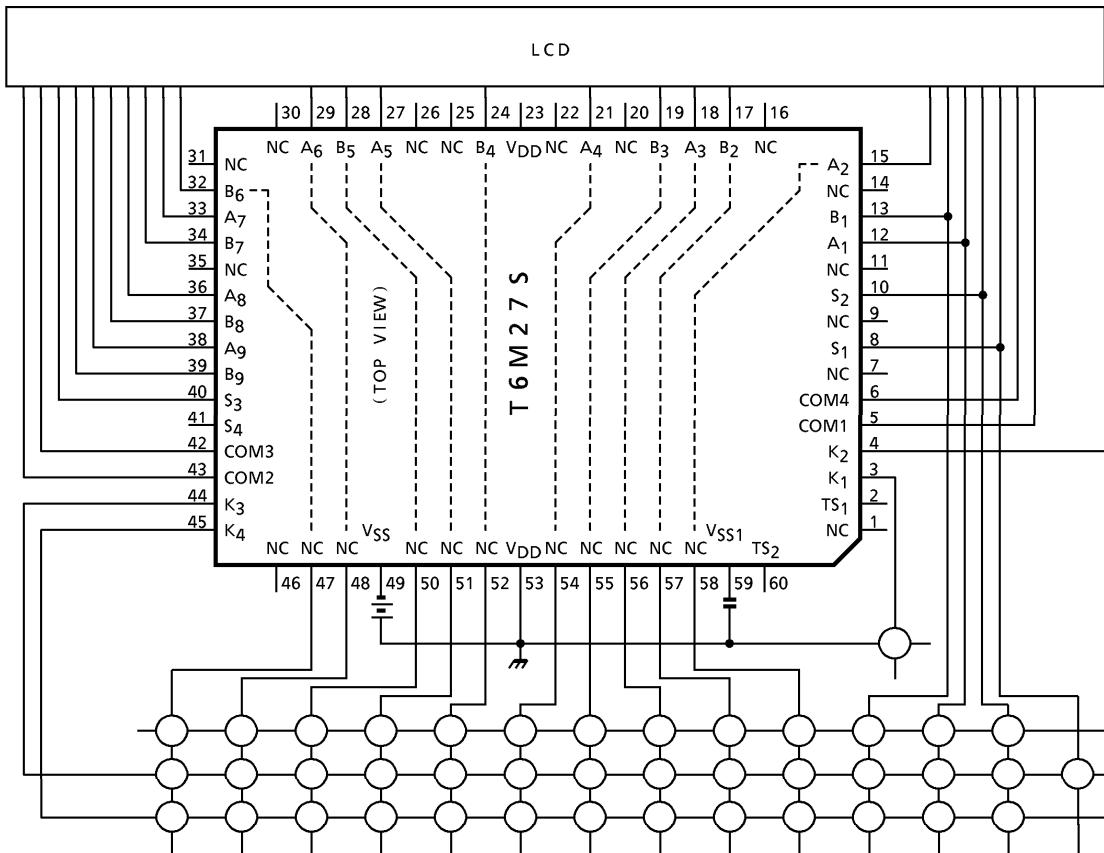


Weight : 0.66g (Typ.)

980910EBA2

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SYSTEM BLOCK DIAGRAM

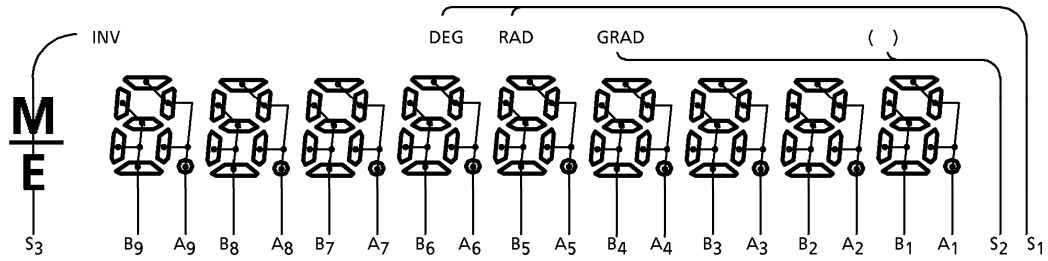


(Note) Input capacity ≤ 300 (pF) at $V_{DD} = -2.6$ (V)
 Key resistance ≤ 1.5 (k Ω) at $V_{DD} = -2.6$ (V)

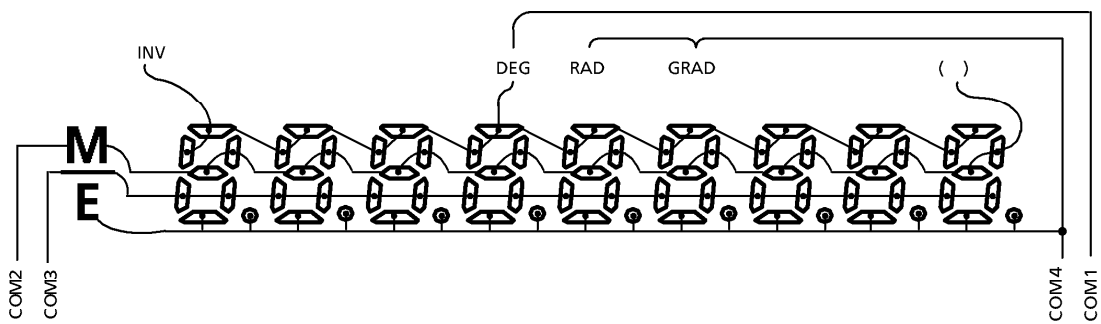
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CONNECTION OF LCD

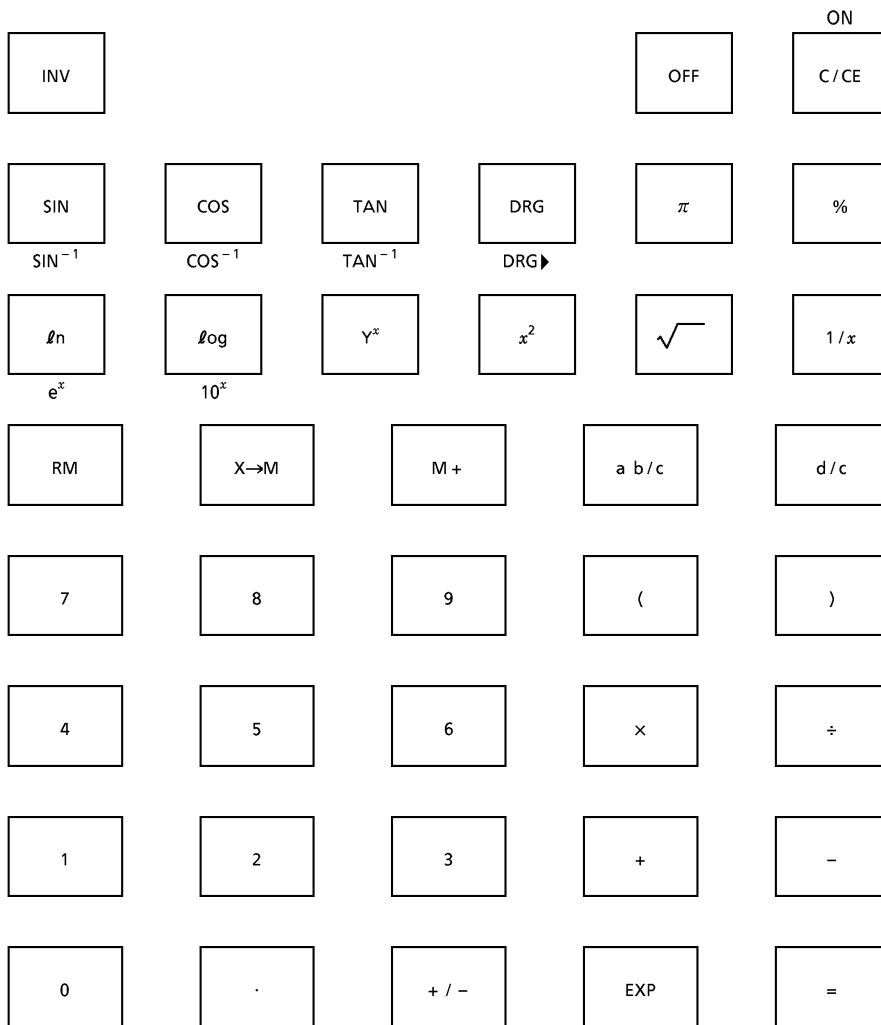
SEGMENT



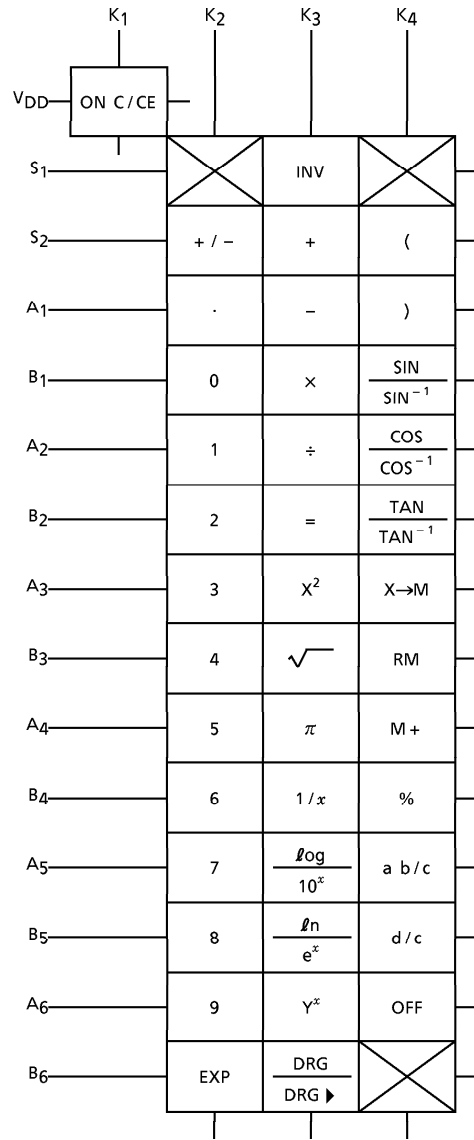
COMMON



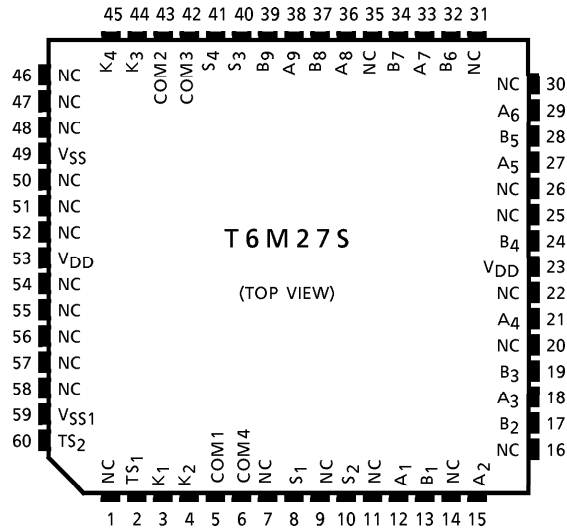
SET KEY LAYOUT (Example)



KEY CONNECTION



PIN ASSIGNMENT



OPERATION EXAMPLE

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Addition, Subtraction				
<ul style="list-style-type: none"> 123 + 654 = 777 19 + 19 + 19 + 19 = 76 2.34 - 3.45 = - 1.11 	123 + 654 = 19 + = = = 2.34 - 3.45 =	777 76 - 1.11		
Multiplication, Division				
<ul style="list-style-type: none"> 98765 × (- 4321) = - 4.26763 × 10⁸ (4.5 × 10⁶) ÷ 7.8 = 576923.08 	98765 × 4321 + / - = 4.5 EXP 6 ÷ 7.8 =	- 4.26763 576923.08		08
Parenthesis				
<ul style="list-style-type: none"> $\frac{11 - 13}{15 + 17} = - 0.0625$ 98 ÷ [(7 + 4) × (5 - 6)] = - 8.9090909 	(11 - 13) ÷ (15 + 17) = 98 ÷ ((7 + 4) × (5 - 6)) =	- 0.0625 - 8.9090909		

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Constant Calculation				
<ul style="list-style-type: none"> • $0.12 + 0.78 = 0.9$ • $0.34 + 0.78 = 1.12$ • $0.56 + 0.78 = 1.34$ • $987 - 100 = 887$ • $654 - 100 = 554$ • $321 - 100 = 221$ • $1.1 \times 4.4 = 4.84$ • $2.2 \times 4.4 = 9.68$ • $3.3 \times 4.4 = 14.52$ • $500 \div 4 = 125$ • $600 \div 4 = 150$ • $700 \div 4 = 175$ • $2^5 = 32$ • $3^5 = 243$ • $4^5 = 1024$ • $12.3 + 4 \times 5.6 = 34.7$ • $23.4 + 4 \times 5.6 = 45.8$ • $34.5 + 4 \times 5.6 = 56.9$ 	$0.12 \boxed{+} 0.78 \boxed{=}$ $0.34 \boxed{=}$ $0.56 \boxed{=}$ $987 \boxed{-} 100 \boxed{=}$ $654 \boxed{=}$ $321 \boxed{=}$ $1.1 \boxed{\times} 4.4 \boxed{=}$ $2.2 \boxed{=}$ $3.3 \boxed{=}$ $500 \boxed{\div} 4 \boxed{=}$ $600 \boxed{=}$ $700 \boxed{=}$ $2 \boxed{y^2} 5 \boxed{=}$ $3 \boxed{=}$ $4 \boxed{=}$ $12.3 \boxed{+} 4 \boxed{\times} 5.6 \boxed{=}$ $23.4 \boxed{=}$ $34.5 \boxed{=}$	0.9 1.12 1.34 887 554 221 4.84 9.68 14.52 125 150 175 32 243 1024 34.7 45.8 56.9		
Memory Calculation				
(Total calculation) $9 \times 8 = 72$ $7 \times 6 = 42$ $+) 5 \times 4 = 20$ <hr/> 134	$\boxed{C} \cdot \boxed{CE} \boxed{X} \rightarrow \boxed{M} 9 \boxed{\times} 8 \boxed{=} \boxed{M} \boxed{+}$ $7 \boxed{\times} 6 \boxed{=} \boxed{M} \boxed{+}$ $5 \boxed{\times} 4 \boxed{=} \boxed{M} \boxed{+} \boxed{RM}$	72 42 20 134		
Fractional Calculation				
<ul style="list-style-type: none"> • $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} = 1 \frac{1}{12}$ • $5 \frac{1}{6} - 7 \frac{1}{8} = -1 \frac{23}{24}$ 	$1 \boxed{ab/c} 2 \boxed{+} 1 \boxed{ab/c} 3 \boxed{+}$ $1 \boxed{ab/c} 4 \boxed{=}$ $\boxed{d/c}$ $\boxed{ab/c}$ $\boxed{ab/c}$ $5 \boxed{ab/c} 1 \boxed{ab/c} 6 \boxed{-} 7 \boxed{ab/c}$ $1 \boxed{ab/c} 8 \boxed{=}$ $\boxed{d/c}$ $\boxed{ab/c}$	$1 \frac{1}{12}$ $13 \frac{1}{12}$ 1.083333 $1 \frac{1}{12}$ $-1 \frac{23}{24}$ $-47 \frac{1}{24}$ -1.9583333		

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	MODE	EXPONENT
Functional Calculation				
(Trigonometry)				
• $\sin 30^\circ = 0.5$ [DEG]	$\boxed{\text{DRG}} \boxed{[\text{DEG}]} \boxed{30} \boxed{\text{SIN}}$	0.5	[DEG]	
• $\cos \frac{2}{3} \pi$ [RAD] = -0.5	$\boxed{\text{DRG}} \boxed{[\text{RAD}]} \boxed{(\boxed{2} \boxed{\div} \boxed{3} \boxed{\times} \boxed{\pi} \boxed{)}}$ $\boxed{\text{COS}}$	-0.5	[RAD]	
• $\tan 150^\circ = -1$ [GRAD]	$\boxed{\text{DRG}} \boxed{[\text{GRAD}]} \boxed{150} \boxed{\text{TAN}}$	-1	[GRAD]	
• $1 - \cos^2 60^\circ = 0.75$ [DEG]	$\boxed{\text{DRG}} \boxed{[\text{DEG}]} \boxed{1} \boxed{-} \boxed{60} \boxed{\text{COS}} \boxed{x^2} \boxed{=}$	0.75	[DEG]	
(Inverse trigonometry)				
• $\sin^{-1} 0.5 = -30^\circ$ [DEG]	$\boxed{\text{DRG}} \boxed{[\text{DEG}]} \boxed{0.5} \boxed{+/-} \boxed{\text{SIN}^{-1}}$	-30	[DEG]	
• $\cos^{-1} 1 = 3.1415927$ [RAD]	$\boxed{\text{DRG}} \boxed{[\text{RAD}]} \boxed{1} \boxed{+/-} \boxed{\text{COS}^{-1}}$	3.1415927	[RAD]	
• $\tan^{-1} 1 = 50^\circ$ [GRAD]	$\boxed{\text{DRG}} \boxed{[\text{GRAD}]} \boxed{1} \boxed{\text{TAN}^{-1}}$	50	[GRAD]	
(Exponential)				
• $e^1 = 2.7182818$	$\boxed{1} \boxed{e^x}$	2.7182818		
• $e^{1.5} \times 10^{2.5} = 1417.2345$	$\boxed{1.5} \boxed{e^x} \boxed{\times} \boxed{2.5} \boxed{10^x} \boxed{=}$	1417.2345		
(Natural logarithm)				
• $\ln 30 = 3.4011974$	$\boxed{30} \boxed{\text{LN}}$	3.4011974		
(Common logarithm)				
• $\log 100 = 2$	$\boxed{100} \boxed{\text{LOG}}$	2		
• $\log \sqrt{3} + \log \sqrt{5} = 0.5880456$	$\boxed{3} \boxed{\sqrt{}} \boxed{\text{LOG}} \boxed{+} \boxed{5} \boxed{\sqrt{}} \boxed{\text{LOG}} \boxed{=}$	0.5880456		
(Square root)				
• $\sqrt{2} = 1.4142136$	$\boxed{2} \boxed{\sqrt{}}$	1.4142136		
• $\sqrt{5} \times \sqrt{7} = 5.9160798$	$\boxed{5} \boxed{\sqrt{}} \boxed{\times} \boxed{7} \boxed{\sqrt{}} \boxed{=}$	5.9160798		
(Square)				
• $3^2 + 4^2 = 25$	$\boxed{3} \boxed{x^2} \boxed{+} \boxed{4} \boxed{x^2} \boxed{=}$	25		
• $(2.34 \times 10^5)^2 = 5.4756 \times 10^{10}$	$\boxed{2.34} \boxed{\text{EXP}} \boxed{5} \boxed{x^2}$	5.4756		10
(Power)				
• $2^{10} = 1024$	$\boxed{2} \boxed{y^2} \boxed{10} \boxed{=}$	1024		
• $3^{-19} = 8.60391 \times 10^{-10}$	$\boxed{3} \boxed{y^2} \boxed{19} \boxed{+/-} \boxed{=}$	8.60391		-10
• $\sqrt[3]{8} (= 8^{1/3}) = 2$	$\boxed{8} \boxed{y^2} \boxed{3} \boxed{1/x} \boxed{=}$	2		
• $\sqrt[4]{81} = 3$	$\boxed{81} \boxed{\sqrt{}} \boxed{\sqrt{}}$	3		
(Reciprocal)				
• $\frac{1}{3} + \frac{1}{5} = 0.5333333$	$\boxed{3} \boxed{1/x} \boxed{+} \boxed{5} \boxed{1/x} \boxed{=}$	0.5333333		
• $\frac{1}{1.23 \times 10^{17}} = 8.13008 \times 10^{-18}$	$\boxed{1.23} \boxed{\text{EXP}} \boxed{17} \boxed{1/x}$	8.13008		-18
Pi Calculation				
• $5 \times \pi = 15.707963$	$\boxed{5} \boxed{\times} \boxed{\pi} \boxed{=}$	15.707963		

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Percent Calculation				
<ul style="list-style-type: none"> What is 15% of 400? $400 \times \frac{15}{100} = 60$ 	400 [×] 15 [%] [=]	60		
<ul style="list-style-type: none"> 3 equals what percent of 24? $\frac{3}{24} \times 100 = 12.5$ 	3 [÷] 24 [%] [=]	12.5		
<ul style="list-style-type: none"> A 25% add on to 800 $800 + 800 \times \frac{25}{100} = 1000$ 	800 [+] 25 [%] [=]	1000		
<ul style="list-style-type: none"> A 18% deduction on 700 $700 - 700 \times \frac{18}{100} = 574$ 	700 [-] 18 [%] [=]	574		

MAXIMUM RATINGS

CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V _{SS}	+ 0.3 ~ - 3.5	V
Input Voltage	V _{IN}	+ 0.3 ~ V _{DD} - 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)

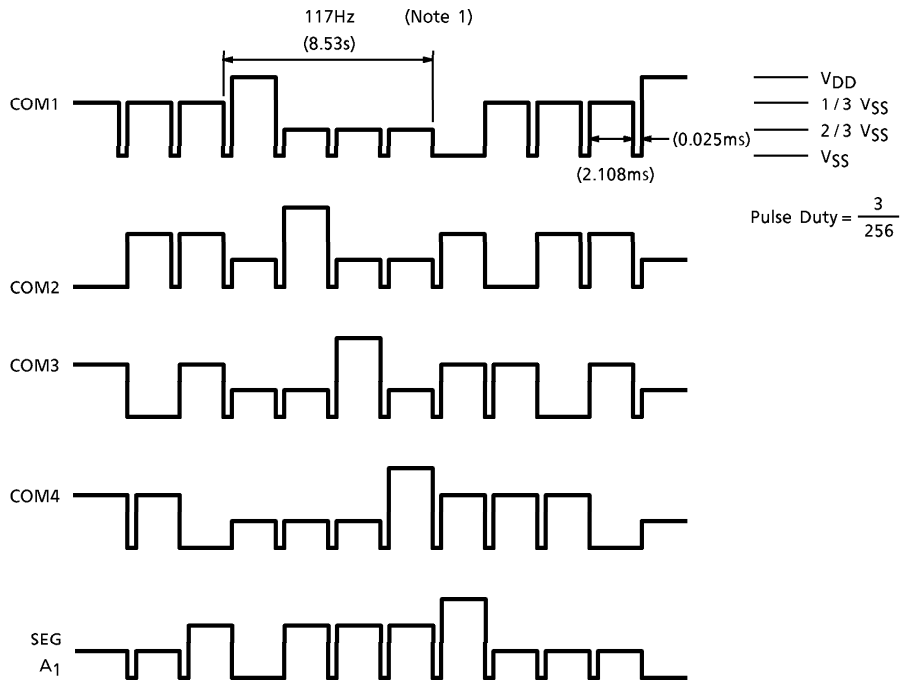
CHARACTERISTICS	SYMBOL	TEST CIRCUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	—	—	—	—	- 2.5	- 3.0	- 3.4	V
Supply Current	I _{DD} WAIT	—	—	V _{SS} = - 3.0V, wait	—	26	—	μA
Supply Current	I _{DD} OP	—	—	V _{SS} = - 3.0V, operate	—	52	78	μA
Supply Current	I _{DD} OFF	—	—	V _{SS} = - 3.0V, off	—	1	3	μA
Oscillating Frequency	f _φ WAIT	—	—	V _{SS} = - 3.0V, wait	18	30	42	kHz
Oscillating Frequency	f _φ OP	—	—	V _{SS} = - 3.0V, operate	42	70	98	kHz
Frame Frequency	fF	—	—	V _{SS} = - 3.0V, wait	70	117	164	Hz
Timer	T timer	—	—	V _{SS} = - 3.0V	428	600	1000	s
"1" Input Voltage	V _{IH}	—	K ₁ ~K ₄	—	V _{SS} + 0.5	—	V _{SS}	V
"0" Input Voltage	V _{IL}	—	K ₁ ~K ₄	—	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

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
"1" Output Resistance	R _{SEG (H)}	—	SEG	V _{OUT} = V _{SS} + 0.5V : 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	27	45	63	kΩ
KEY PULL DOWN Resistance	R _{PULL DOWN}	—	K _{2~K4}	V _{OUT} = V _{SS}	27	45	63	kΩ
"M" Output Resistance	R _{OM}	—	SEG	V _{OUT} = $\frac{1}{3}$ V _{SS} - 0.5V	—	100	—	kΩ
"M" Output Resistance	R _{OM}	—	SEG	V _{OUT} = $\frac{2}{3}$ V _{SS} + 0.5V	—	100	—	kΩ
"M" Output Resistance	R _{OM}	—	COM	V _{OUT} = $\frac{1}{3}$ V _{SS} - 0.5V	—	77	—	kΩ
"M" Output Resistance	R _{OM}	—	COM	V _{OUT} = $\frac{2}{3}$ V _{SS} + 0.5V	—	77	—	kΩ
"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~K4}	(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	—	$\frac{2}{3}$ V _{SS} + 0.2	$\frac{2}{3}$ V _{SS}	$\frac{2}{3}$ V _{SS} - 0.2	V
"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	V
"0" Output Voltage	V _{OL}	—	SEG COM	—	V _{DD}	V _{DD}	V _{DD} - 0.2	V

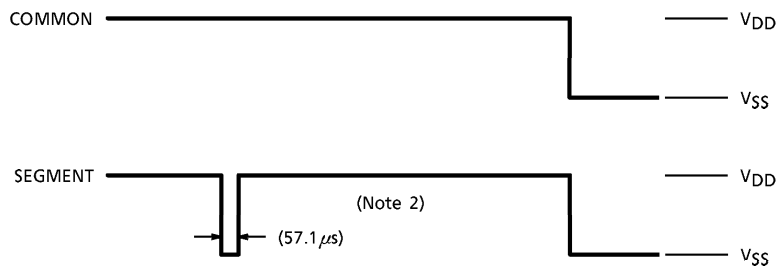
(Note 1) The key buffer is high impedance at keystroke.

WAVEFORMS FOR DISPLAY

Display



Key pulse output

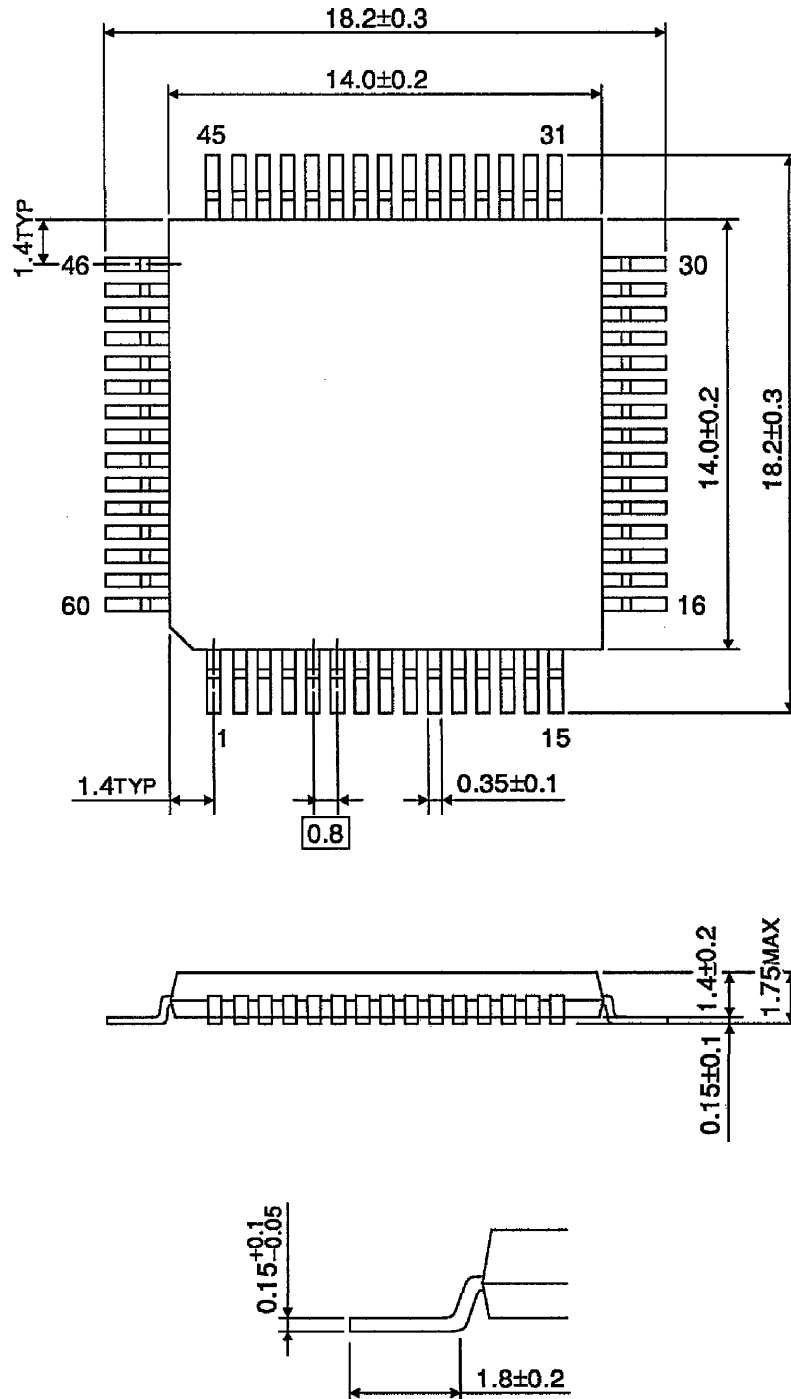


(Note 1) F_{ϕ} WAIT = 30kHz

(Note 2) F_{ϕ} OP = 70kHz

PACKAGE DIMENSIONS
LQFP60-P-1414-0.80

Unit : mm



Weight : 0.66g (Typ.)