

# T6M27S

## T6M27S SINGLE-CHIP CMOS LSI FOR LCD CALCULATORS

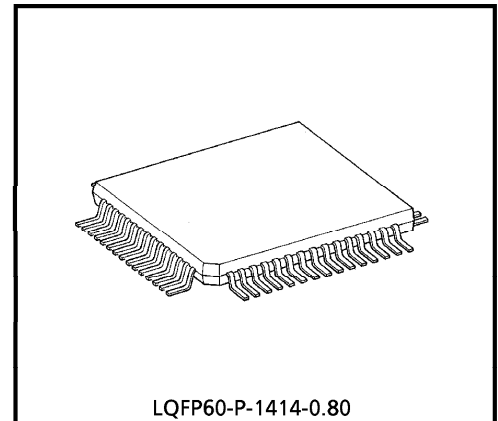
The T6M27S is single-chip microcomputer for 8-digit + 1-digit scientific calculation.

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.

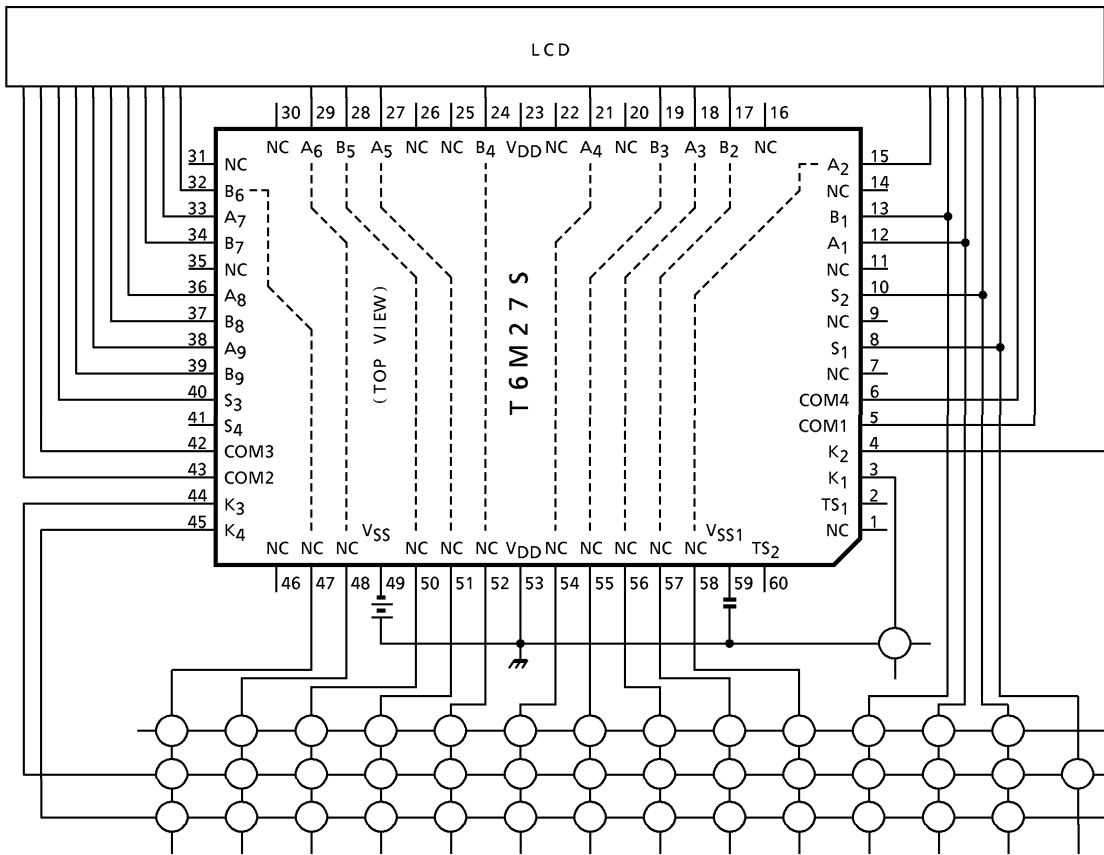


Weight : 0.66g (Typ.)

980910EBA2

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SYSTEM BLOCK DIAGRAM

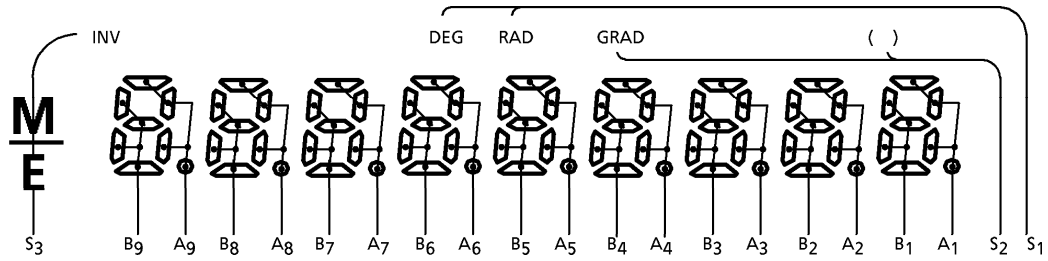


(Note) Input capacity  $\leq 300$  (pF) at  $V_{DD} = -2.6$  (V)  
 Key resistance  $\leq 1.5$  (k $\Omega$ ) at  $V_{DD} = -2.6$  (V)

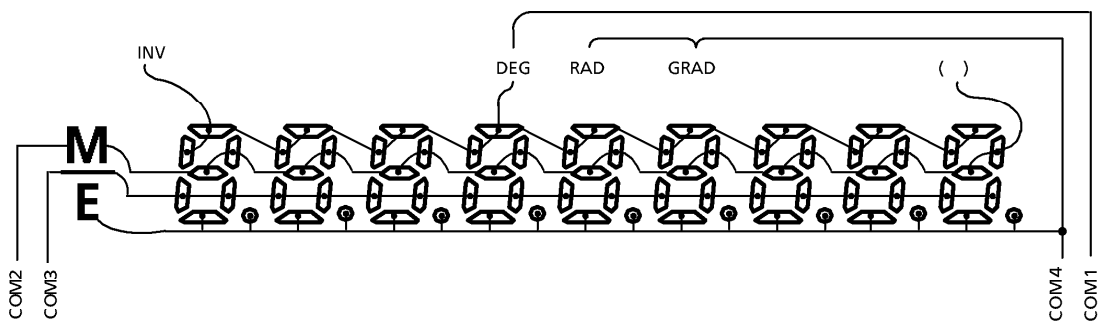
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CONNECTION OF LCD

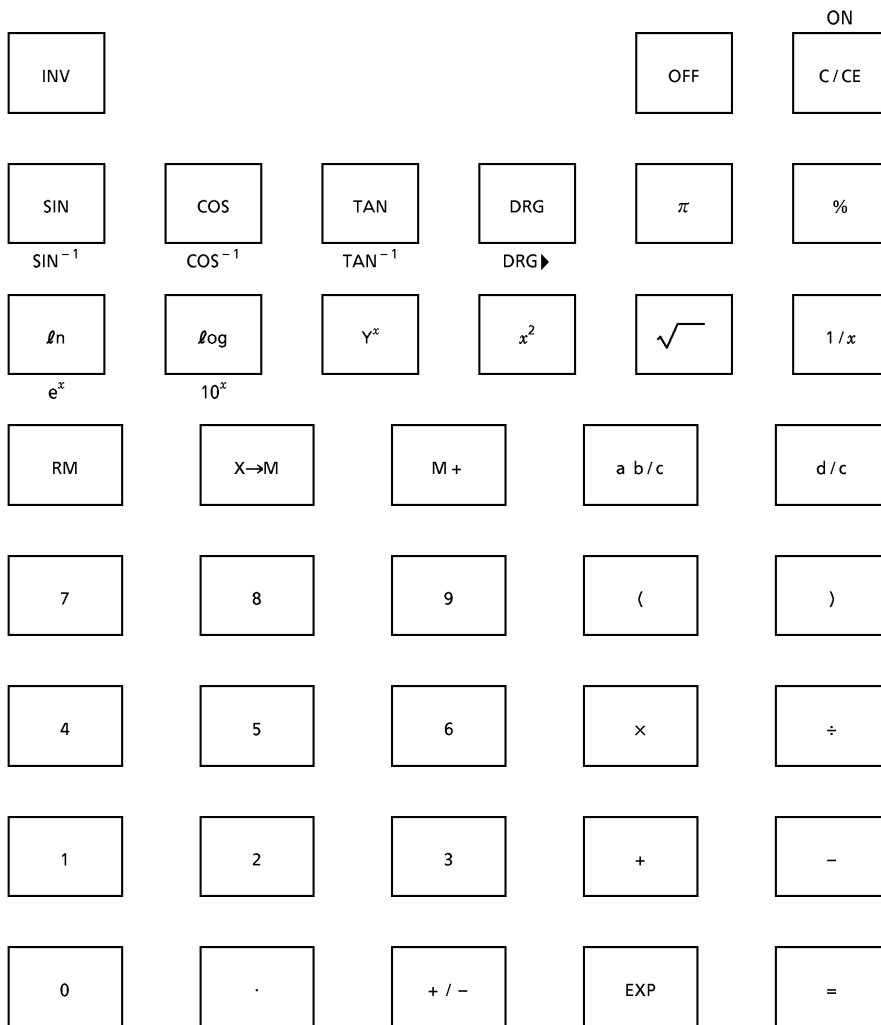
SEGMENT



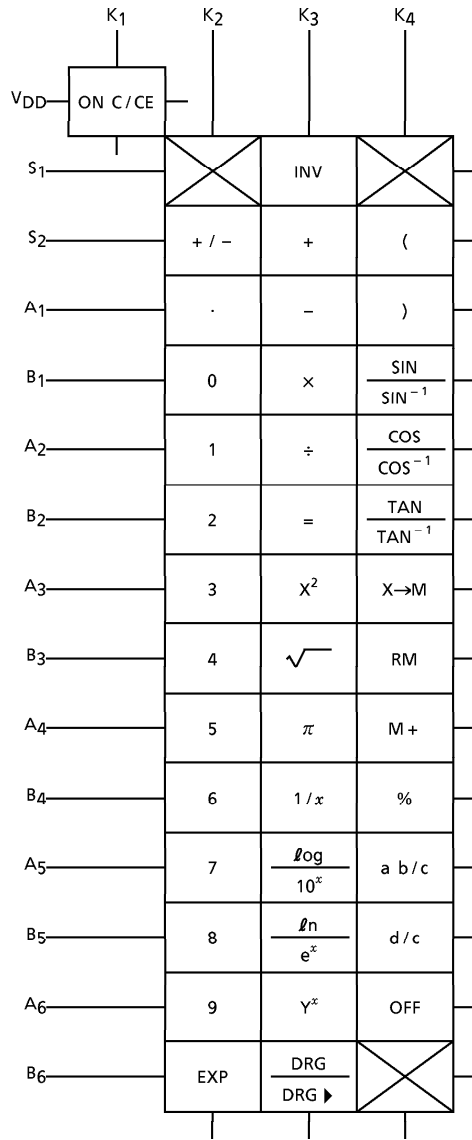
COMMON



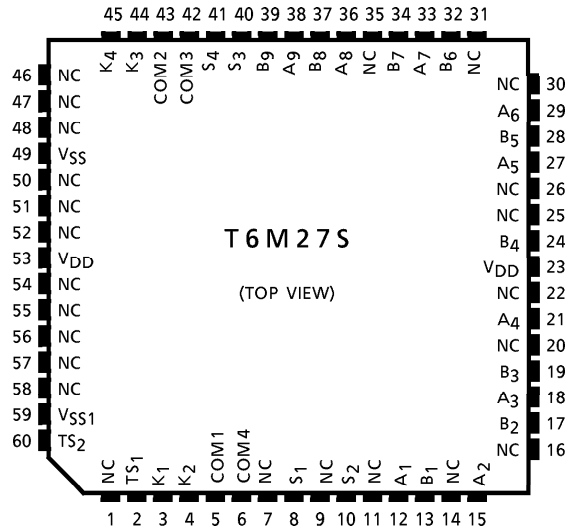
SET KEY LAYOUT (Example)



KEY CONNECTION



PIN ASSIGNMENT



OPERATION EXAMPLE

CALCULATION EXAMPLE	KEY OPERATION	DISPLAY		
		MANTISSA	SIGN	EXPONENT
Addition, Subtraction				
<ul style="list-style-type: none"> <li>123 + 654 = 777</li> <li>19 + 19 + 19 + 19 = 76</li> <li>2.34 - 3.45 = - 1.11</li> </ul>	123 $\boxed{+}$ 654 $\boxed{=}$ 19 $\boxed{+}$ $\boxed{=}$ $\boxed{=}$ $\boxed{=}$ 2.34 $\boxed{-}$ 3.45 $\boxed{=}$	777 76 - 1.11		
Multiplication, Division				
<ul style="list-style-type: none"> <li>98765 × (- 4321) = - 4.26763 × 10<sup>8</sup></li> <li>(4.5 × 10<sup>6</sup>) ÷ 7.8 = 576923.08</li> </ul>	98765 $\boxed{\times}$ 4321 $\boxed{+ / -}$ $\boxed{=}$ 4.5 $\boxed{\text{EXP}}$ 6 $\boxed{\div}$ 7.8 $\boxed{=}$	- 4.26763 576923.08		08
Parenthesis				
<ul style="list-style-type: none"> <li><math>\frac{11 - 13}{15 + 17} = - 0.0625</math></li> <li>98 ÷ [(7 + 4) × (5 - 6)] = - 8.9090909</li> </ul>	$\boxed{(}$ 11 $\boxed{-}$ 13 $\boxed{)}$ $\boxed{\div}$ $\boxed{(}$ 15 $\boxed{+}$ 17 $\boxed{=}$ 98 $\boxed{\div}$ $\boxed{(}$ $\boxed{(}$ 7 $\boxed{+}$ 4 $\boxed{)}$ $\boxed{\times}$ $\boxed{(}$ 5 $\boxed{-}$ 6 $\boxed{=}$	- 0.0625 - 8.9090909		

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

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



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

**MAXIMUM RATINGS**

CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>SS</sub>	+ 0.3 ~ - 3.5	V
Input Voltage	V <sub>IN</sub>	+ 0.3 ~ V <sub>DD</sub> - 0.3	V
Operating Temperature	T <sub>opr</sub>	0 ~ 40	°C
Storage Temperature	T <sub>stg</sub>	- 55 ~ 125	°C

**ELECTRICAL CHARACTERISTICS (V<sub>SS</sub> = - 3.0 ± 0.2V, V<sub>DD</sub> = 0V, Ta = 25 ± 1.5°C)**

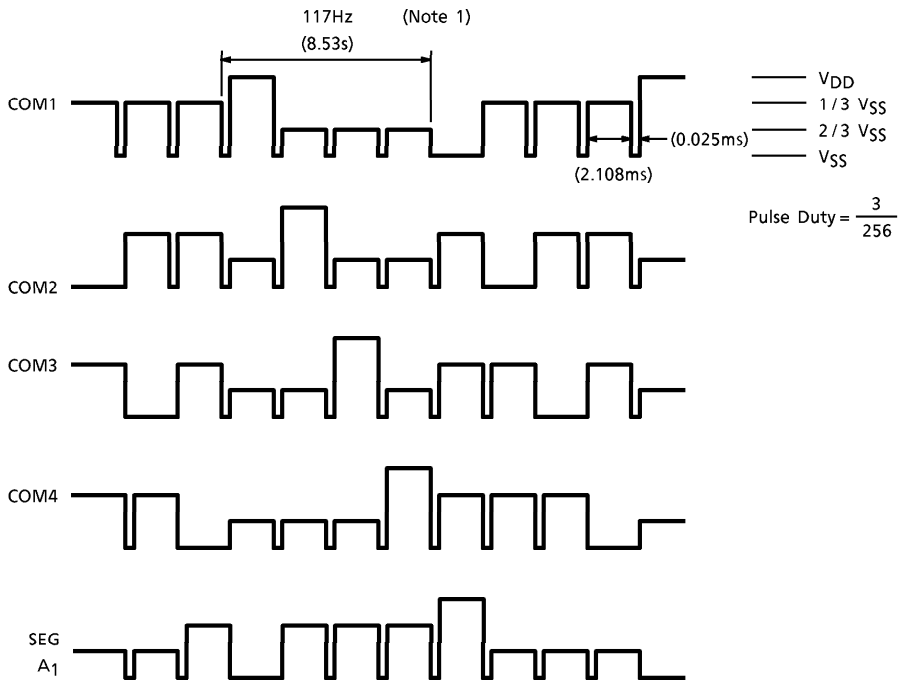
CHARACTERISTICS	SYMBOL	TEST CIRCUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	—	—	—	—	- 2.5	- 3.0	- 3.4	V
Supply Current	I <sub>DD</sub> WAIT	—	—	V <sub>SS</sub> = - 3.0V, wait	—	26	—	μA
Supply Current	I <sub>DD</sub> OP	—	—	V <sub>SS</sub> = - 3.0V, operate	—	52	78	μA
Supply Current	I <sub>DD</sub> OFF	—	—	V <sub>SS</sub> = - 3.0V, off	—	1	3	μA
Oscillating Frequency	f $\phi$ WAIT	—	—	V <sub>SS</sub> = - 3.0V, wait	18	30	42	kHz
Oscillating Frequency	f $\phi$ OP	—	—	V <sub>SS</sub> = - 3.0V, operate	42	70	98	kHz
Frame Frequency	fF	—	—	V <sub>SS</sub> = - 3.0V, wait	70	117	164	Hz
Timer	T timer	—	—	V <sub>SS</sub> = - 3.0V	428	600	1000	s
"1" Input Voltage	V <sub>IH</sub>	—	K <sub>1</sub> ~K <sub>4</sub>	—	V <sub>SS</sub> + 0.5	—	V <sub>SS</sub>	V
"0" Input Voltage	V <sub>IL</sub>	—	K <sub>1</sub> ~K <sub>4</sub>	—	V <sub>DD</sub>	—	- 0.5	V
"1" Output Resistance	R <sub>KEY</sub>	—	SEG	V <sub>OUT</sub> = V <sub>SS</sub> + 0.5V : KEY STROBE	—	—	2	kΩ
"0" Output Resistance	R <sub>SEG</sub> (L)	—	SEG	V <sub>OUT</sub> = V <sub>DD</sub> - 0.5V	—	—	90	kΩ

CHARACTERISTICS	SYMBOL	TEST CIRCUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
"1" Output Resistance	R <sub>SEG (H)</sub>	—	SEG	V <sub>OUT</sub> = V <sub>SS</sub> + 0.5V : KEY STROBE	—	—	90	kΩ
"0" Output Resistance	R <sub>COM (L)</sub>	—	COM	V <sub>OUT</sub> = V <sub>DD</sub> - 0.5V	—	—	25	kΩ
"1" Output Resistance	R <sub>COM (H)</sub>	—	COM	V <sub>OUT</sub> = V <sub>SS</sub> + 0.5V	—	—	25	kΩ
KEY PULL UP Resistance	R <sub>PULL UP</sub>	—	K <sub>1</sub>	V <sub>OUT</sub> = 0V	27	45	63	kΩ
KEY PULL DOWN Resistance	R <sub>PULL DOWN</sub>	—	K <sub>2</sub> ~K <sub>4</sub>	V <sub>OUT</sub> = V <sub>SS</sub>	27	45	63	kΩ
"M" Output Resistance	R <sub>OM</sub>	—	SEG	V <sub>OUT</sub> = $\frac{1}{3}$ V <sub>SS</sub> - 0.5V	—	100	—	kΩ
"M" Output Resistance	R <sub>OM</sub>	—	SEG	V <sub>OUT</sub> = $\frac{2}{3}$ V <sub>SS</sub> + 0.5V	—	100	—	kΩ
"M" Output Resistance	R <sub>OM</sub>	—	COM	V <sub>OUT</sub> = $\frac{1}{3}$ V <sub>SS</sub> - 0.5V	—	77	—	kΩ
"M" Output Resistance	R <sub>OM</sub>	—	COM	V <sub>OUT</sub> = $\frac{2}{3}$ V <sub>SS</sub> + 0.5V	—	77	—	kΩ
"1" Output Voltage	V <sub>OH</sub>	—	K <sub>1</sub>	(Note 1)	V <sub>SS</sub> + 0.2	V <sub>SS</sub>	V <sub>SS</sub>	V
"0" Output Voltage	V <sub>OL</sub>	—	K <sub>2</sub> ~K <sub>4</sub>	(Note 1)	V <sub>DD</sub>	V <sub>DD</sub>	V <sub>DD</sub> - 0.2	V
"1" Output Voltage	V <sub>OH</sub>	—	SEG COM	—	V <sub>SS</sub> + 0.2	V <sub>SS</sub>	V <sub>SS</sub>	V
"M" Output Voltage	V <sub>OM</sub>	—	SEG COM	—	$\frac{2}{3}$ V <sub>SS</sub> + 0.2	$\frac{2}{3}$ V <sub>SS</sub>	$\frac{2}{3}$ V <sub>SS</sub> - 0.2	V
"M" Output Voltage	V <sub>OM</sub>	—	SEG COM	—	$\frac{1}{3}$ V <sub>SS</sub> + 0.2	$\frac{1}{3}$ V <sub>SS</sub>	$\frac{1}{3}$ V <sub>SS</sub> - 0.2	V
"0" Output Voltage	V <sub>OL</sub>	—	SEG COM	—	V <sub>DD</sub>	V <sub>DD</sub>	V <sub>DD</sub> - 0.2	V

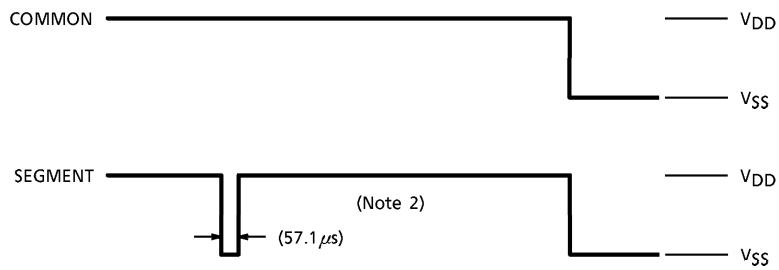
(Note 1) The key buffer is high impedance at keystroke.

WAVEFORMS FOR DISPLAY

Display



Key pulse output

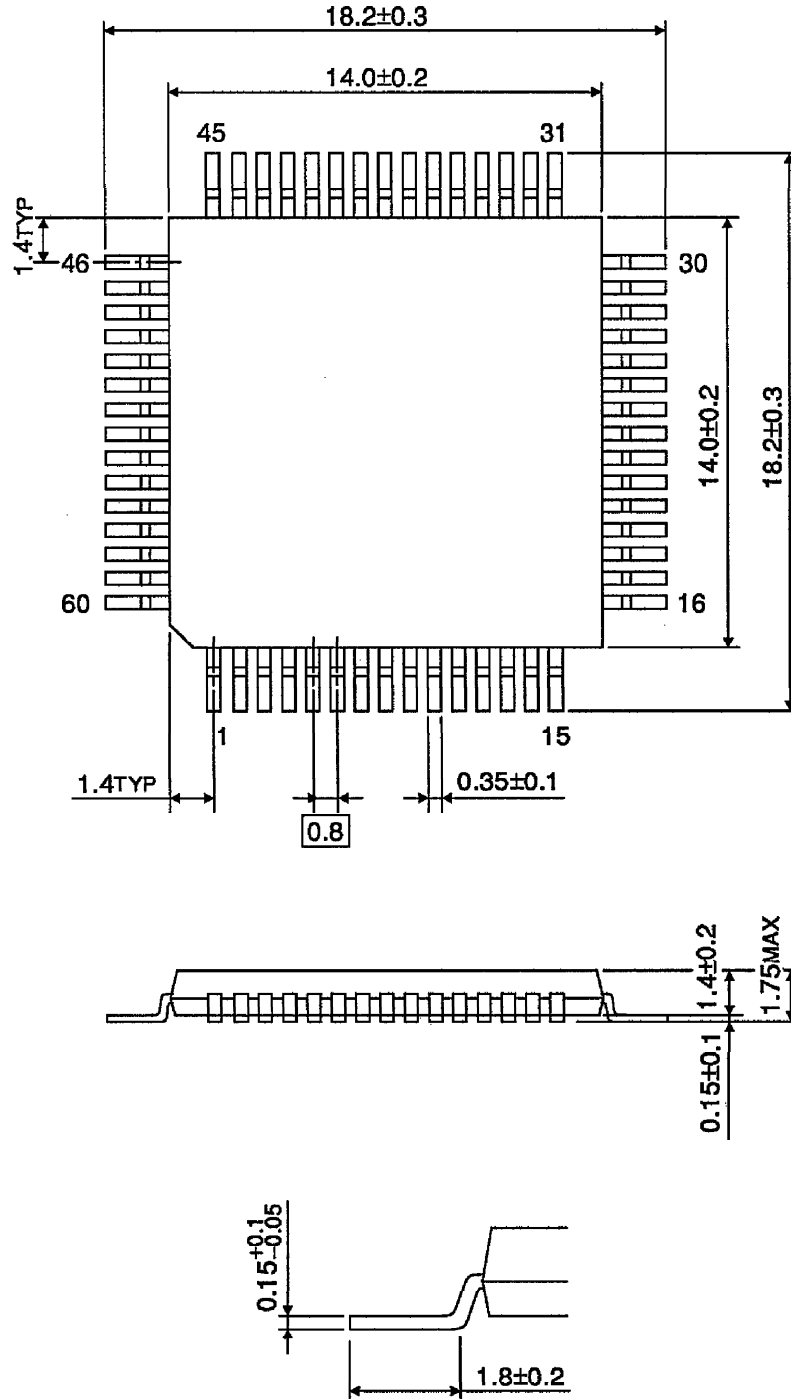


(Note 1)  $F_{\phi}$  WAIT = 30kHz

(Note 2)  $F_{\phi}$  OP = 70kHz

PACKAGE DIMENSIONS  
LQFP60-P-1414-0.80

Unit : mm



Weight : 0.66g (Typ.)