

**TOSHIBA**

**T9790U**

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# T9790U

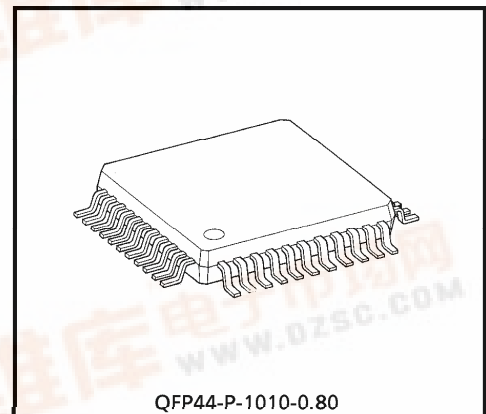
## T9790U CMOS 1 CHIP LSI FOR LCD ELECTRONIC CALCULATOR

The T9790U is a 1 chip microcomputer for 8-digits 1-memory electronic calculator.

T9790U can drive the liquid crystal display (LCD). Single power supply operation, low power consumption make it suitable for single battery operated pocketable calculator.

### FEATURES

- 8 digits of data and 1 symbol digit for calculator.
- Algebraic calculation mode.
- Punctuation.
- Standard 4 functions (+, -, ×, ÷), mark up percent with automatic add-on/discount, automatic constant calculations, chain calculations, memory calculations with memory overflow protection.
- Internal keyboard decoding and denouncing.
- Complementary output buffer for direct driving of liquid crystal display (LCD : FEM type 3.0V, 1/2 bias, 1/3 duty).
- Single power supply (1.4V typ.).
- Quad in line flat package (44 PIN).
- Very low power consumption (2.66 $\mu$ W typ. at wait).
- Very wide range of operating voltage ( $V_{DD} = 1.1 \sim 1.9V$ ).
- Automatic power off (A time for about 7 min.).



QFP44-P-1010-0.80

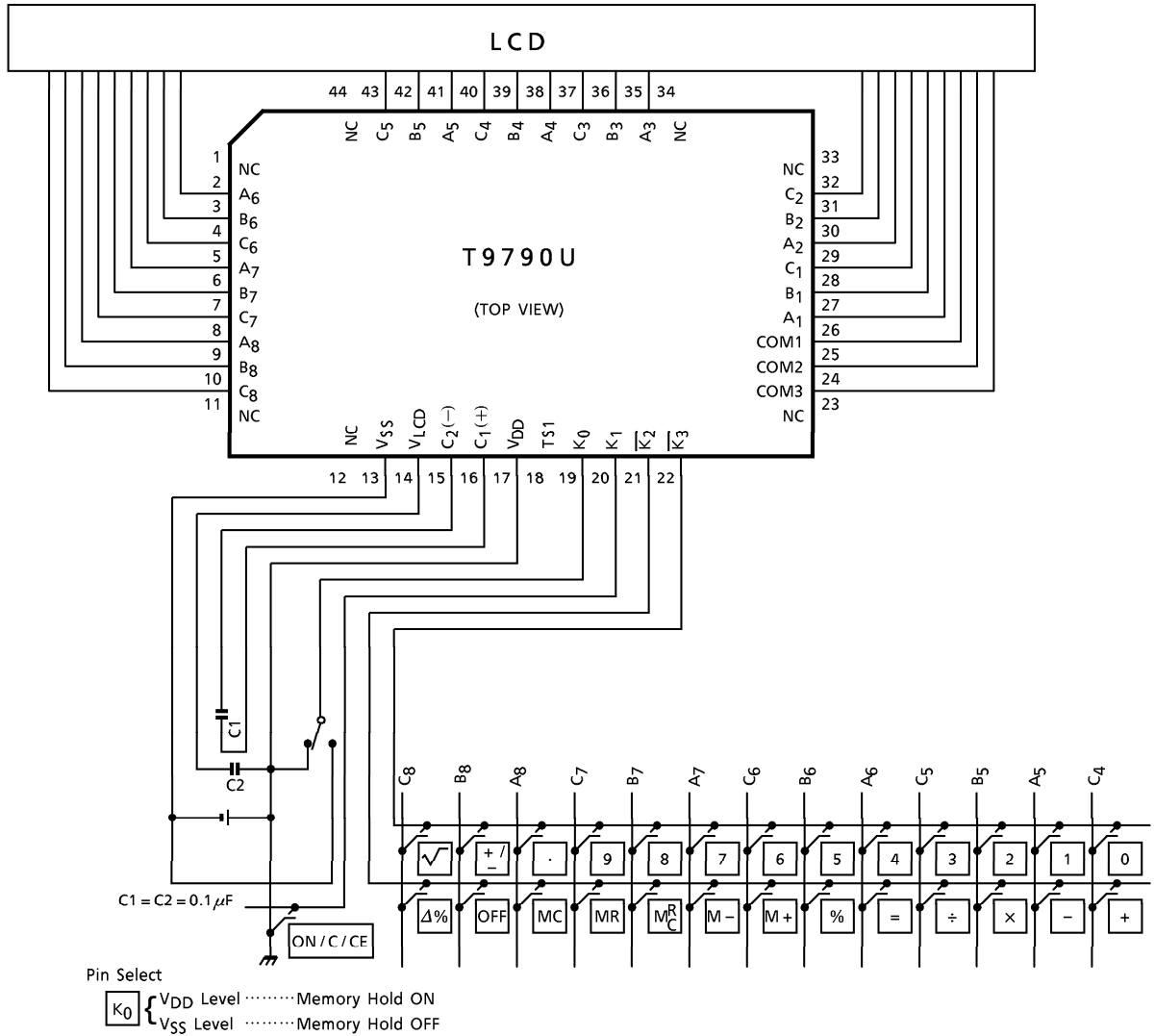
Weight : 0.34g (Typ.)

980910EBA2

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SYSTEM BLOCK DIAGRAM

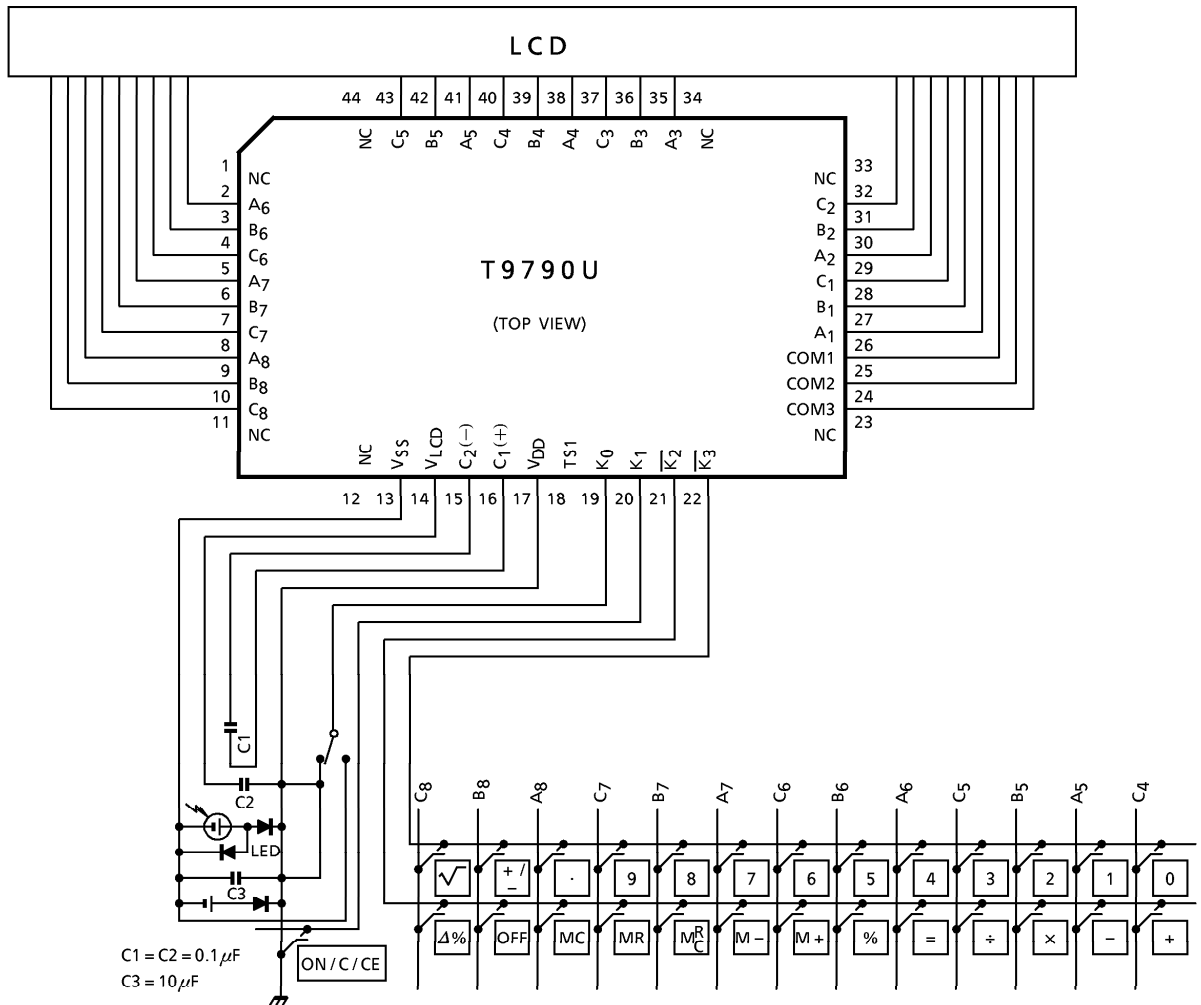
Battery Type



NOTE

INPUT capacity ≤ 400 (pF) at V<sub>DD</sub> = 1.4 (V)  
 Key resistance ≤ 3 (kΩ) at V<sub>DD</sub> = 1.4 (V)

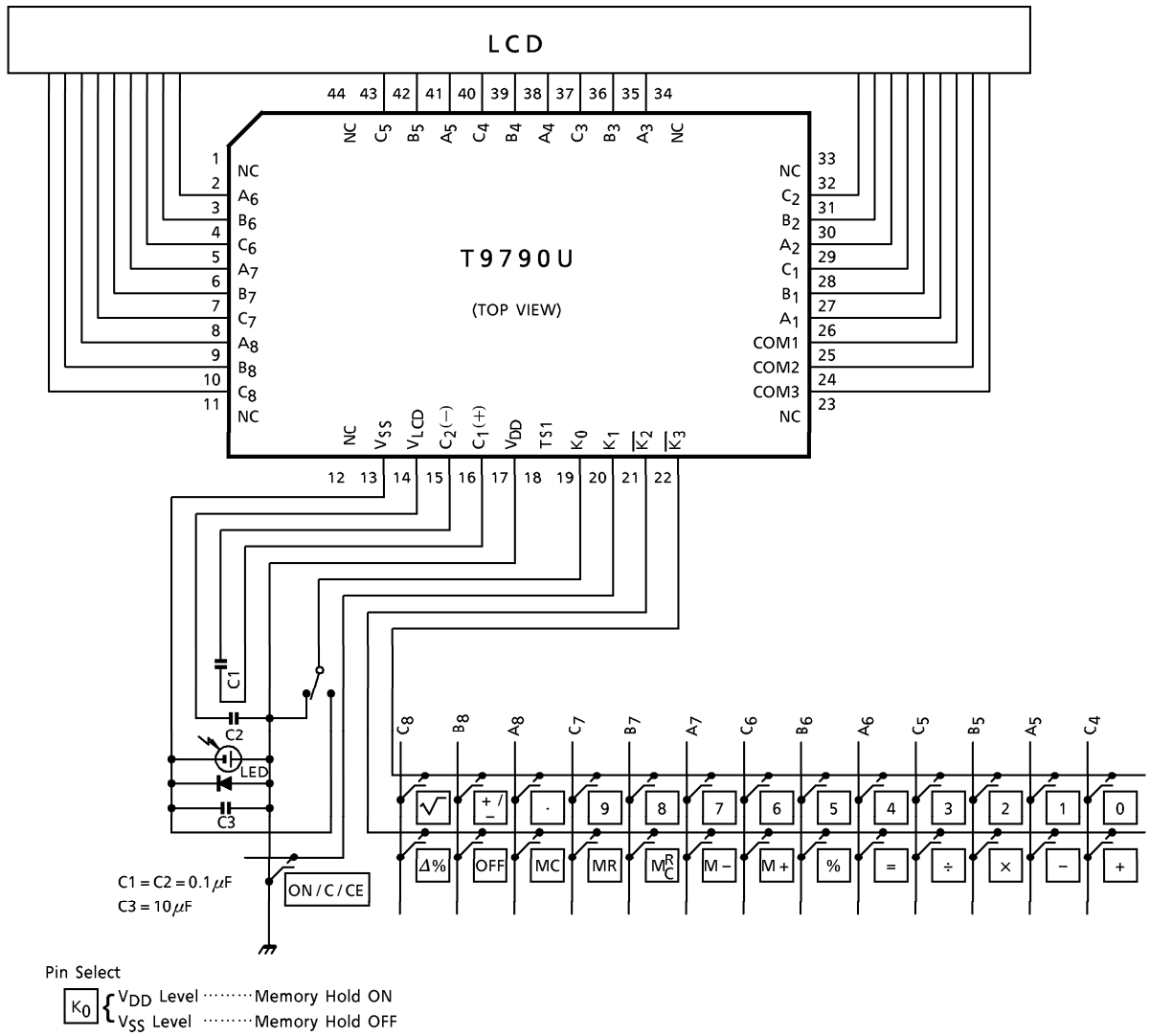
Dual Type



Pin Select  
 K<sub>0</sub> { V<sub>DD</sub> Level ..... Memory Hold ON  
 V<sub>SS</sub> Level ..... Memory Hold OFF

NOTE  
 INPUT capacity ≤ 400 (pF) at V<sub>DD</sub> = 1.4 (V)  
 Key resistance ≤ 3 (kΩ) at V<sub>DD</sub> = 1.4 (V)

Solar Type

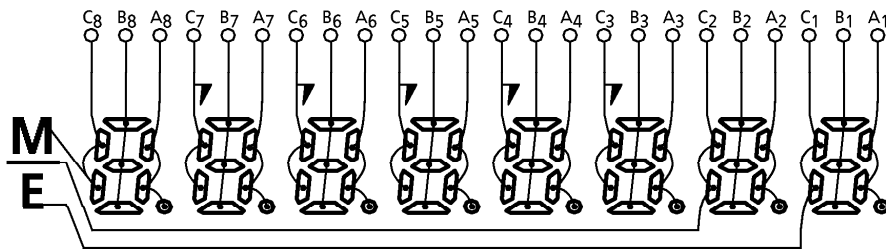


NOTE

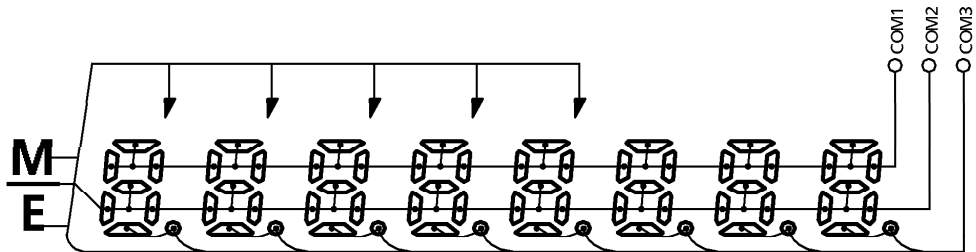
INPUT capacity ≤ 400 (pF) at V<sub>DD</sub> = 1.4 (V)  
Key resistance ≤ 3 (kΩ) at V<sub>DD</sub> = 1.4 (V)

CONNECTION OF LCD

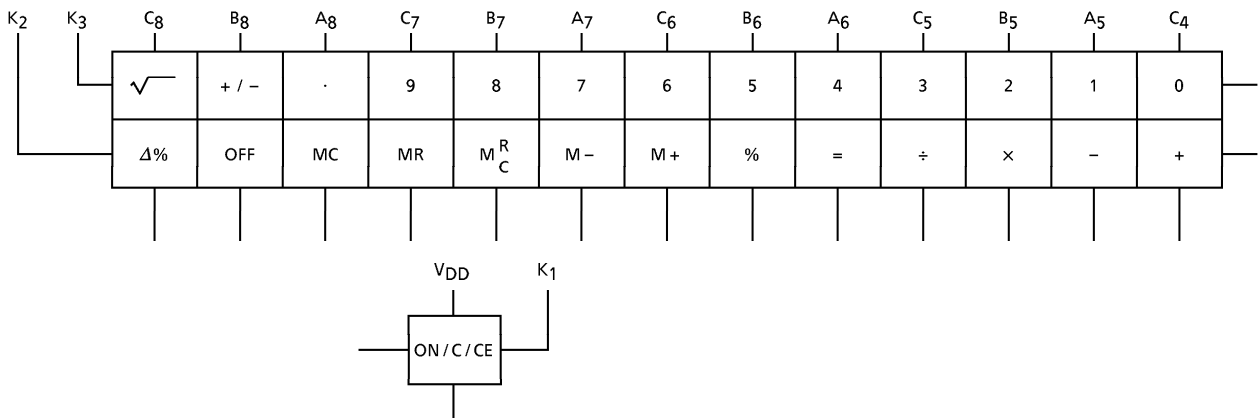
SEGMENT



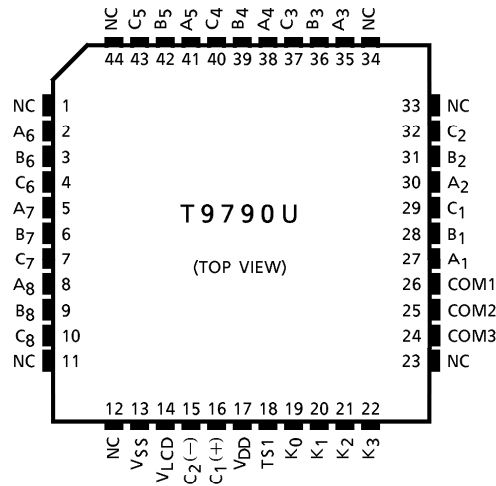
COMMON



KEY LAYOUT



**PIN LAYOUT**



**SPECIFICATION OF CALCULATOR**

**Operational Features**

- (1) 8 digits of data and 1 symbol digit.
- (2) Algebraic mode.
- (3) Full floating point.
- (4) Standard 4 functions +, -, ×, ÷.
- (5) Memory calculation and memory hold.
- (6) Delta Percent, mark-up and mark-down functions.
- (7) Percent with automatic add-on and discount.
- (8) Constant calculation (Automatic constant).
- (9) Chain calculation.
- (10) Leading zero suppression.
- (11) Trailing zero suppression.
- (12) Square root.
- (13) Change sign.

## Capacity of Calculation

- |     |                           |                                      |
|-----|---------------------------|--------------------------------------|
| (1) | Numeral entry             | 8 digits                             |
| (2) | Addition / Subtraction    | 8 digits + ( - ) 8 digits = 8 digits |
| (3) | Multiplication / Division | 8 digits × ( ÷ ) 8 digits = 8 digits |
| (4) | Memory calculation        | 8 digits + ( - ) 8 digits = 8 digits |

## Display Font

## Overflow Condition

- (1) When division by zero is attempted, an overflow condition will result, and error symbol "E" and a zero are displayed.
- (2) When the integer part of result exceeds 8 digits, the display will shown 8 most significant digits of result divided by  $10^{+8}$  and "E".
- (3) When the integer part of result exceeds 15 digits, display will show a zero and "E".
- (4) When the integer part of result in memory register exceeds 8 digits at memory calculation, display will show a zero and "E", and previous data will be kept in memory register.
- (5) When an overflow occurs on the way of add-on / discount calculation, display will show a zero and "E".
- (6) In overflow condition, any operation or numeral entry will be inhibited.

## Clearing Overflow Condition

- (1) The resulting overflow condition can be cleared by depressing **ON/C/CE** .
- (2) At memory overflow condition, depression of **MR** or **M<sub>C</sub><sup>R</sup>** after **ON/C/CE** will recall the previous memory data.
- (3) At the condition of exceeding capacity overflow occurred in chain calculation, depression of **ON/C/CE** will reset the error symbol "E", and you can continue the calculation using the displayed data.

Speed of Calculation

(1)	Numeral entry			56.0~59.3ms
(2)	Addition	11111111 $\boxed{+}$	11111111 $\boxed{=}$	102.6~105.9ms
(3)	Multiplication	1 $\boxed{\times}$	99999999 $\boxed{=}$	258.6~261.9ms
(4)	Division	99999999 $\boxed{\div}$	1 $\boxed{=}$	294.6~297.9ms
(5)	Memory Calculation	99999999 $\boxed{\div}$	1 $\boxed{M+}$	345.3~348.6ms
(6)	Percentage calculation	1 $\boxed{+}$	99999999 $\boxed{\%}$	287.9~291.2ms
(7)	Square root		99999999 $\boxed{\sqrt{\quad}}$	259.9~263.2ms

Arithmetic Operations

1. Addition

Key Op.	Display
A	A
$\boxed{+}$	A
B	B
$\boxed{+}$	A + B
C	C
$\boxed{=}$	A + B + C
D	D
$\boxed{+}$	D
E	E
$\boxed{+}$	D + E
$\boxed{=}$	D + E

2. Subtraction

(1)	A	A
	$\boxed{-}$	A
	B	B
	$\boxed{-}$	A - B
	C	C
	$\boxed{=}$	A - B - C
	$\boxed{-}$	A - B - C
	D	D



	Key Op.	Display
	$\boxed{+ / -}$	- D
	$\boxed{-}$	A - B - C + D
	$\boxed{=}$	- (A - B - C + D)
3. Multiplication		
(1)	A	A
	$\boxed{\times}$	A
	B	B
	$\boxed{=}$	A·B
	$\boxed{+}$	A·B
	C	C
	$\boxed{=}$	A·B + C
(2)	$\boxed{-}$	0.
	A	A
	$\boxed{\times}$	- A
	B	B
	$\boxed{=}$	- A·B
4. Division		
(1)	A	A
	$\boxed{\div}$	A
	B	B
	$\boxed{=}$	A / B
(2)	$\boxed{-}$	0.
	A	A.
	$\boxed{\div}$	- A
	B	B
	$\boxed{=}$	- A / B
5. Power calculation		
(1)	A	A
	$\boxed{\times}$	A

	Key Op.	Display
	$\boxed{=}$	$A^2$
	$\boxed{=}$	$A^3$
(2)	A	A
	$\boxed{\div}$	A
	$\boxed{=}$	$1/A$
	$\boxed{=}$	$1/A^2$
(3)	$\boxed{-}$	0.
	A	A
	$\boxed{\times}$	-A
	$\boxed{=}$	$A^2$
	$\boxed{=}$	$-A^3$
(4)	$\boxed{-}$	0.
	A	A
	$\boxed{\div}$	-A
	$\boxed{=}$	$-1/A$
	$\boxed{=}$	$1/A^2$
(5)	A	A
	$\boxed{\times}$	A
	$\boxed{=}$	$A^2$
	$\boxed{\times}$	$A^2$
	$\boxed{=}$	$A^4$

6. Mixed calculation

(1)	A	A
	$\boxed{\times}$	A
	B	B
	$\boxed{+}$	A·B
	C	C
	$\boxed{\div}$	$A \cdot B + C$
	D	D

7. Constant calculation

	Key Op.	Display
	$\frac{-}{\square}$	$\frac{A \cdot B + C}{D}$
	E	E
	$\frac{=}{\square}$	$\frac{A \cdot B + C}{D} - E$
(1)	A	A
	$\frac{\times}{\square}$	A
	B	B
	$\frac{=}{\square}$	A · B
	C	C
	$\frac{=}{\square}$	A · C
(2)	$\frac{-}{\square}$	0.
	A	A
	$\frac{\times}{\square}$	- A
	B	B
	$\frac{=}{\square}$	- A · B
	C	C
	$\frac{=}{\square}$	- A · C
(3)	A	A
	$\frac{\div}{\square}$	A
	B	B
	$\frac{=}{\square}$	A / B
	C	C
	$\frac{=}{\square}$	C / B
	D	D
	$\frac{\times}{\square}$	D
	$\frac{=}{\square}$	D <sup>2</sup>
(4)	A	A
	$\frac{+}{\square}$	A
	B	B

	Key Op.	Display
	$\boxed{=}$	A + B
	C	C
	$\boxed{=}$	C + B
(5)	A	A
	$\boxed{-}$	A
	B	B
	$\boxed{=}$	A - B
	C	C
	$\boxed{=}$	C - B
(6)	A	A
	$\boxed{\times}$	A
	B	B
	$\boxed{=}$	A · B
	C	C
	$\boxed{\times}$	C
	D	D
	$\boxed{=}$	C · D
	E	E
	$\boxed{=}$	C · E
	$\boxed{\times}$	C · E
	F	F
	$\boxed{=}$	C · E · F
	G	G
	$\boxed{\div}$	G
	H	H
	$\boxed{=}$	G / H
	I	I
	$\boxed{=}$	I / H

	Key Op.	Display
(7)	A	A
	$\times$	A
	B	B
	$\%$	$A \cdot B / 100$
	C	C
	$\%$	$A \cdot C / 100$
	D	D
	$\div$	D
	E	E
	$\%$	$100 \cdot D / E$
	F	F
	$\%$	$100 \cdot F / E$

8. Mark-up/Discount calculator

(1)	A	A
	$\times$	A
	B	B
	$+$	$A \cdot B$
	$=$	$A + A \cdot B$
(2)	A	A
	$\times$	A
	B	B
	$-$	$A \cdot B$
	$=$	$A - A \cdot B$
(3)	A	A
	$\times$	A
	B	B
	$\%$	$A \cdot B / 100$
	$+$	$A \cdot B / 100$
$=$	$A + A \cdot B / 100$	

	Key Op.	Display
(4)	A	A
	$\times$	A
	B	B
	$\%$	$A \cdot B / 100$
	$-$	$A \cdot B / 100$
	$=$	$A - A \cdot B / 100$
(5)	A	A
	$+$	A
	B	B
	$\%$	$A + AB / 100$
(6)	A	A
	$-$	A
	B	B
	$\%$	$A - AB / 100$

9. Memory calculation

	Key Op.	Display	Memory
	A	A	0.
	$M+$	A (M)	A
	B	B (M)	A
	$M+$	B (M)	A + B
	C	C (M)	A + B
	$M-$	C (M)	A + B - C
	D	D (M)	A + B - C
	$M^R_C$ or $MR$	A + B - C (M)	A + B - C
	$M^R_C$ or $MC$	A + B - C	0.
(2)	A	A	0.
	$+$	A	0.
	B	B	0.
	$M+$	A + B (M)	A + B

	Key Op.	Display	Memory
	$\boxed{+}$	A + B (M)	A + B
	$\boxed{M+}$	A + B (M)	2 (A + B)
	C	C (M)	2 (A + B)
	$\boxed{M-}$	C (M)	2 (A + B) - C
(3)	A	A	0.
	$\boxed{\times}$	A	0.
	B	B	0.
	$\boxed{M+}$	A·B (M)	A·B
	C	C (M)	A·B
	$\boxed{\times}$	C (M)	A·B
	D	D (M)	A·B
	$\boxed{M-}$	C·D (M)	AB - CD
	$\boxed{MR_C}$ or $\boxed{MR}$	A·B - C·D (M)	AB - CD
	$\boxed{M-}$	A·B - C·D	0.
(4)	A	A	0.
	$\boxed{\times}$	A	0.
	B	B	0.
	$\boxed{=}$	A·B	0.
	C	C	0.
	$\boxed{M+}$	C (M)	C
	$\boxed{=}$	A·C (M)	C
	D	D (M)	C
	$\boxed{M-}$	D (M)	C - D
	$\boxed{=}$	A·D (M)	C - D
(5)	A	A	0.
	$\boxed{M+}$	A (M)	A
	B	B (M)	A
	$\boxed{M+}$	B (M)	A + B
	$\boxed{MR_C}$ or $\boxed{MR}$	A + B (M)	A + B

Key Op.	Display	Memory
$\times$	A + B (M)	A + B
$M^R_C$ or $MR$	A + B (M)	A + B
$+$	$(A + B)^2$ (M)	A + B
C	C (M)	A + B
$=$	$(A + B)^2 + C$ (M)	A + B
(6) 1.0000001	1.0000001	0.
$M+$	1.0000001 (M)	1.0000001
99999999	99999999. (M)	1.0000001
$M+$	0. ( $\frac{M}{E}$ )	1.0000001
$ON/C/CE$	0. (M)	1.0000001
$M^R_C$ or $MR$	1.0000001 (M)	1.0000001

10. Square root

(1)	A	A
	$\sqrt{\square}$	$\sqrt{A}$
	B	B
(2)	A	A
	$\times$	A
	B	B
	$\sqrt{\square}$	$\sqrt{B}$
	$=$	$A\sqrt{B}$
(3)	A	A
	$\times$	A
	$\sqrt{\square}$	$\sqrt{A}$
	B	B
	$=$	A·B
(4)	$-$	0.
	A	A
	$=$	-A
	$\sqrt{\square}$	$\sqrt{A}(E)$



	Key Op.	Display	Memory
(5)	A	A	0.
	$M+$	A (M)	A
	$M^R_C$ or $MR$	A (M)	A
	$\div$	A (M)	A
	B	B (M)	A
	$+ / -$	- B (M)	A
	$\sqrt{\quad}$	$\sqrt{B} (M)$ E	A
	$ON / C / CE$	0. (M)	A

11. Percentage calculation

(1)	A	A
	$\times$	A
	B	B
	$\%$	$A \cdot B / 100$
	C	C
	$\%$	$A \cdot C / 100$
	D	D
	$\%$	$A \cdot D / 100$
(2)	A	A
	$\%$	A
	B	B
	$\%$	B
	C	C
	$\%$	C
(3)	A	A
	$-$	A
	B	B
	$\%$	$A - A \cdot B / 100$
	$-$	$A - A \cdot B / 100$
	$+$	$A - A \cdot B / 100$

	Key Op.	Display	Memory
	C		
	$\boxed{\%}$	$\left(A - \frac{A \cdot B}{100}\right) + \frac{\left(A - \frac{A \cdot B}{100}\right) \cdot C}{100}$	
12.Key correction			
(1)	A	A	0.
	$\boxed{\times}$	A	0.
	$\boxed{\div}$	A	0.
	$\boxed{-}$	A	0.
	$\boxed{+}$	A	0.
	$\boxed{\sqrt{\quad}}$	$\sqrt{A}$	0.
	$\boxed{M+}$	$A + \sqrt{A} (M)$	$A + \sqrt{A}$
	$\boxed{+ / -}$	$-(A + \sqrt{A}) (M)$	$A + \sqrt{A}$
	$\boxed{M^R_C}$ or $\boxed{MR}$	$A + \sqrt{A} (M)$	$A + \sqrt{A}$
	$\boxed{M^R_C}$ or $\boxed{MR}$	$A + \sqrt{A}$	0.
	B	B	0.
	$\boxed{+}$	B	0.
	$\boxed{-}$	B	0.
	$\boxed{\times}$	B	0.
	$\boxed{\div}$	B	0.
	$\boxed{=}$	1 / B	0.
13.Others			
(1)	A	A	
	$\boxed{+}$	A	
	$\boxed{=}$	A	
(2)	A	A	
	$\boxed{\times}$	A	
	$\boxed{\div}$	A	
	$\boxed{=}$	1 / A	
(3)	A	A	
	$\boxed{\div}$	A	

	Key Op.	Display	Memory
	$\boxed{+}$	A	
	$\boxed{=}$	A	
(4)	A	A	
	$\boxed{\times}$	A	
	$\boxed{-}$	A	
	$\boxed{=}$	-A	
(5)	A	A	
	$\boxed{\div}$	A	
	$\boxed{-}$	A	
	$\boxed{=}$	-A	
(6)	A	A	
	$\boxed{\times}$	A	
	$\boxed{\text{ON/C/CE}}$	0.	
	B	B	
	$\boxed{=}$	B	
(7)	A	A	
	$\boxed{\times}$	A	
	B	B	
	$\boxed{\text{ON/C/CE}}$	0.	
	C	C	
	$\boxed{=}$	A·C	

14. Delta Percentage key function

(1)	A	A	
	$\boxed{+}$	A	
	B	B	
	$\boxed{\Delta\%}$	$(A + B) / B \cdot 100$	
(2)	A	A	
	$\boxed{\div}$	A	
	B	B	

	Key Op.	Display	Memory
	$\Delta\%$	$A / (1 - B / 100)$	
	$\Delta\%$	$ A / (1 - B / 100) - A $	
(3)	A	A	
	$\times$	A	
	B	B	
	$\Delta\%$	$A (1 + B / 100)$	
(4)	A	A	
	$\times$	A	
	B	B	
	+ / -	- B	
	$\Delta\%$	$A (1 - B / 100)$	

#### Key Chattering Protection

- (1) At time of key on : about 6.2~9.5ms, after key input ( $f\phi$  typ.)
- (2) At time of key off : about 30.8ms, after completion of the operation ( $f\phi$  typ.)
- (3) Simultaneous keying protection.

If 2 or more keys are pressed simultaneously, any key input is not accepted.

**MAXIMUM RATINGS**

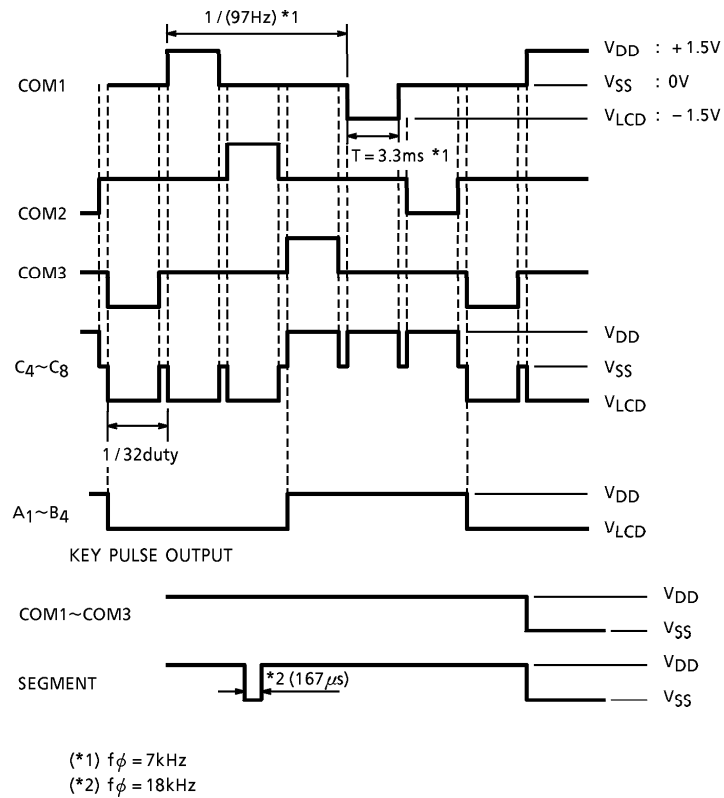
PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V <sub>DD</sub>	- 0.3 ~ + 2.1	V
Input Voltage	V <sub>IN</sub>	- 0.3 ~ V <sub>DD</sub> + 0.3	V
Operating Temperature	T <sub>opr</sub>	0 ~ 40	°C
Storage Temperature	T <sub>stg</sub>	- 55 ~ 125	°C

**ELECTRICAL CHARACTERISTICS (V<sub>DD</sub> = 1.4V ± 0.2V, V<sub>SS</sub> = 0V, Ta = 25°C)**

PARAMETER	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT	
Operating Voltage	V <sub>DD</sub>	—	—	—	1.1	1.4	1.9	V	
"1" Input Voltage	V <sub>IH</sub>	—	K <sub>1</sub> ~ $\overline{K_3}$	—	V <sub>DD</sub> - 0.4	—	V <sub>DD</sub>	V	
"0" Input Voltage	V <sub>IL</sub>	—	K <sub>1</sub> ~ $\overline{K_3}$	—	0	—	0.4	V	
"1" Output Voltage	V <sub>OH</sub>	—	Segment Common	—	V <sub>DD</sub> - 0.2	—	V <sub>DD</sub>	V	
"0" Output Voltage	V <sub>OL</sub>	—	Segment Common	—	V <sub>DD</sub> + 0.2	—	- V <sub>DD</sub>	V	
"1" Output Voltage	V <sub>OH</sub>	—	$\overline{K_2}$ ~ $\overline{K_3}$	—	V <sub>DD</sub> - 0.2	—	V <sub>DD</sub>	V	
"0" Output Voltage	V <sub>OL</sub>	—	K <sub>1</sub>	—	0	—	0.2	V	
"M" Output Voltage	V <sub>OM</sub>	—	Common	—	V <sub>SS</sub> + 0.2	—	V <sub>SS</sub> - 0.2	V	
Output Resistance	"1"	R <sub>OH</sub>	—	Segment	V <sub>OUT</sub> = V <sub>DD</sub> - 0.5V Key Strobe	—	—	70	kΩ
	"0"	R <sub>OL</sub>	—	Segment	V <sub>OUT</sub> = V <sub>LCD</sub> + 0.5V	—	—	70	
	"1"	R <sub>OH</sub>	—	Common	V <sub>OUT</sub> = V <sub>DD</sub> - 0.5V	—	—	70	
	"0"	R <sub>OL</sub>	—	Common	V <sub>OUT</sub> = V <sub>LCD</sub> + 0.5V	—	—	70	
Output Resistance	"M"	R <sub>OM</sub>	—	Common	V <sub>OUT</sub> = V <sub>SS</sub> + 0.5V	—	—	10	kΩ
Key Pull Down Resistance	R pull down	—	K <sub>1</sub>	V <sub>OUT</sub> = V <sub>DD</sub>	45	80	240	kΩ	
Key Pull up Resistance	R pull up	—	$\overline{K_2}$ ~ $\overline{K_3}$	V <sub>OUT</sub> = 0V	45	80	240	kΩ	
"0" Output Resistance	R <sub>KEY</sub>	—	Segment	V <sub>OUT</sub> = V <sub>SS</sub> + 0.5V Key Strobe	—	—	10	kΩ	
Input Leakage Current	I <sub>IL</sub>	—	K <sub>0</sub>	0 ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>	—	—	± 1.0	μA	
Current Consumption (Wait)	I <sub>DD1</sub>	—	—	V <sub>DD</sub> = 1.4V (Key Open)	—	1.9	3.3	μA	
Current Consumption (OP)	I <sub>DD2</sub>	—	—	V <sub>DD</sub> = 1.1V (ALL 9√ Peak)	—	3.0	4.0	μA	
Current Consumption (OFF)	I <sub>DD OFF</sub>	—	—	V <sub>DD</sub> = 1.4V	—	—	1.0	μA	
Oscillating Frequency	f <sub>φ</sub> (Wait)	—	—	V <sub>DD</sub> = 1.4V   f <sub>φ</sub> (Typ.) = Wait	4.2	7	9.8	kHz	
	f <sub>φ</sub> (OP)	—	—	V <sub>DD</sub> = 1.4V   f <sub>φ</sub> (Typ.) = Operate	10.8	18	25.2		
Frame Frequency	f <sub>F</sub>	—	—	V <sub>DD</sub> = 1.4V (Wait)	58	97	136	Hz	
Power off Timer	Timer	—	—	V <sub>DD</sub> = 1.4V	300	420	700	s	

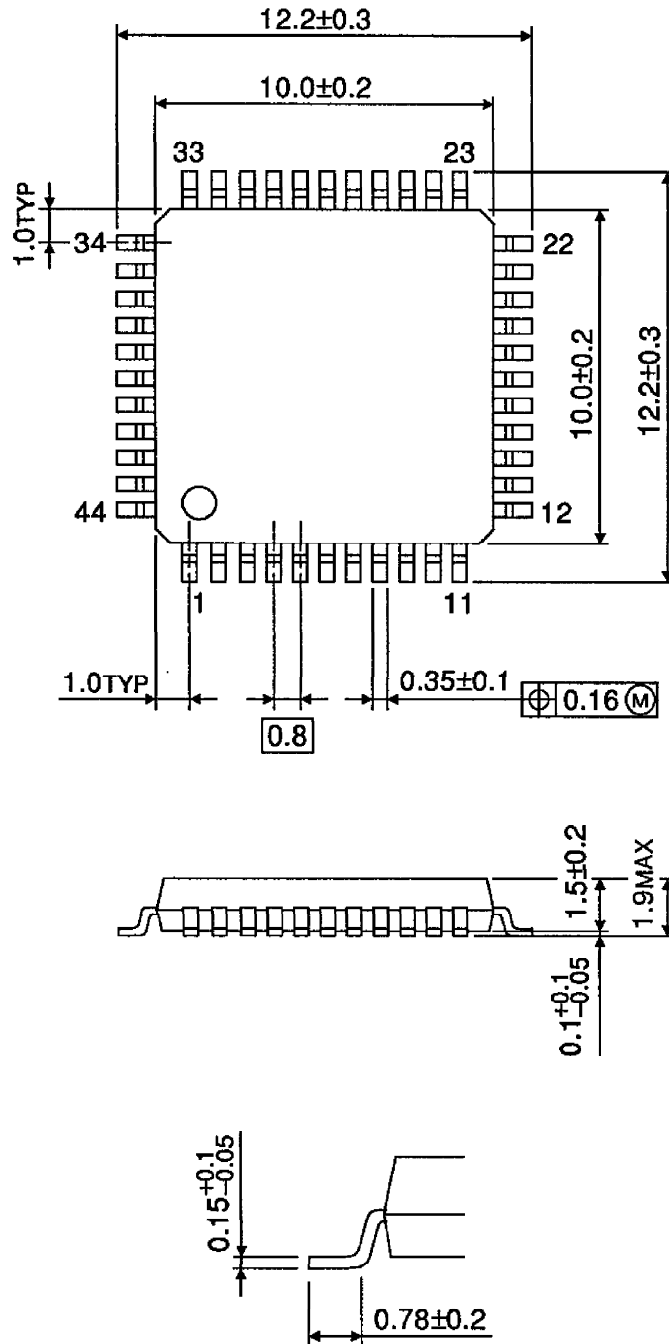
WAVEFORMS FOR DISPLAY

Display Device : FEM type LCD 3.0V, 1/2 bias, 1/3 duty dynamic system



OUTLINE DRAWING  
QFP44-P-1010-0.80

Unit : mm



Weight : 0.34g (Typ.)