

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T9790U

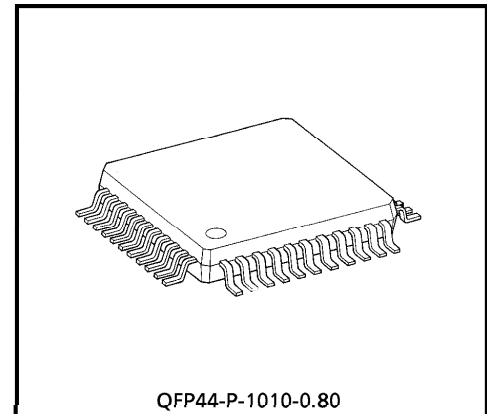
T9790U CMOS 1 CHIP LSI FOR LCD ELECTRONIC CALCULATOR

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 μ 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

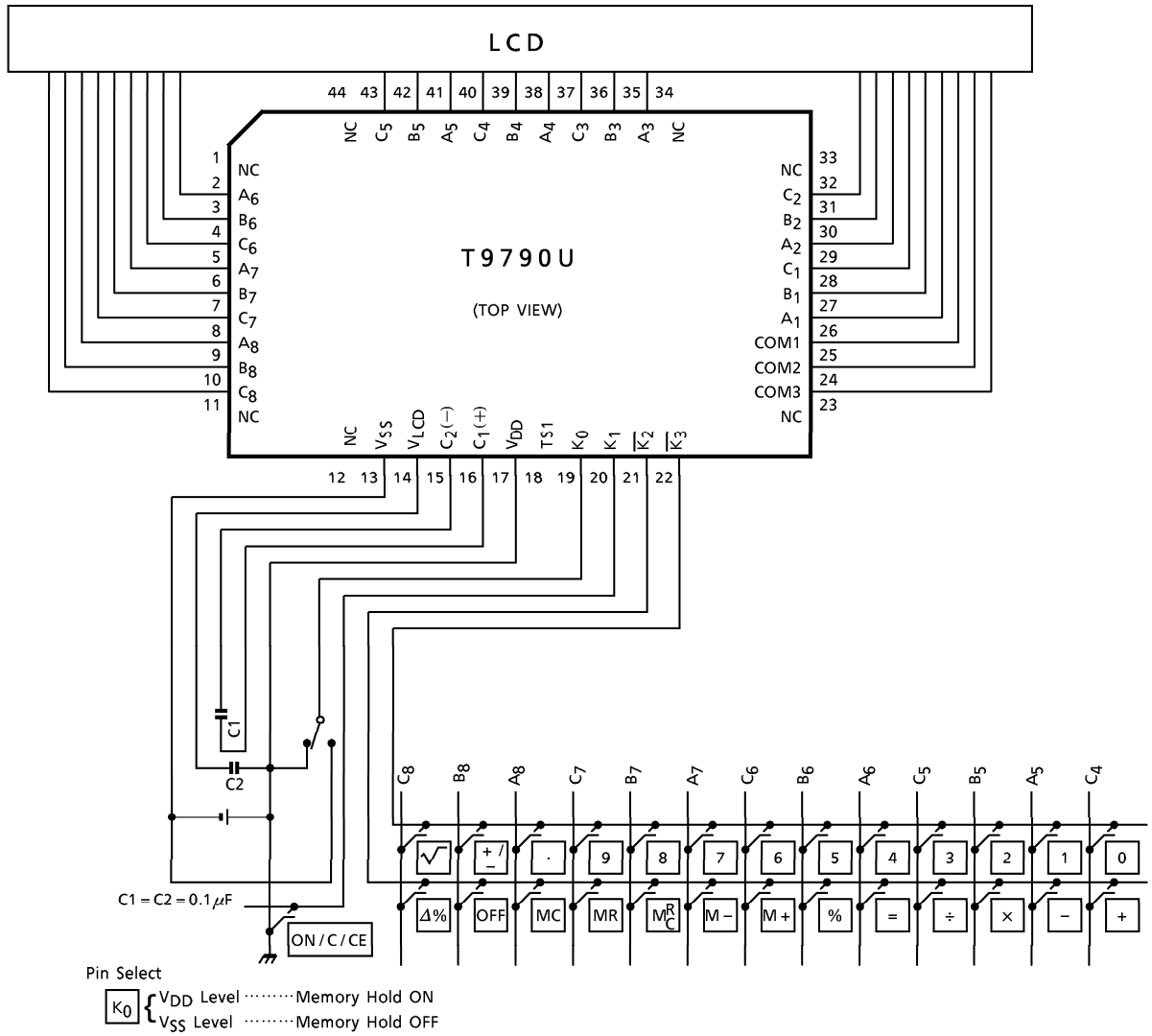
Weight : 0.34g (Typ.)

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SYSTEM BLOCK DIAGRAM

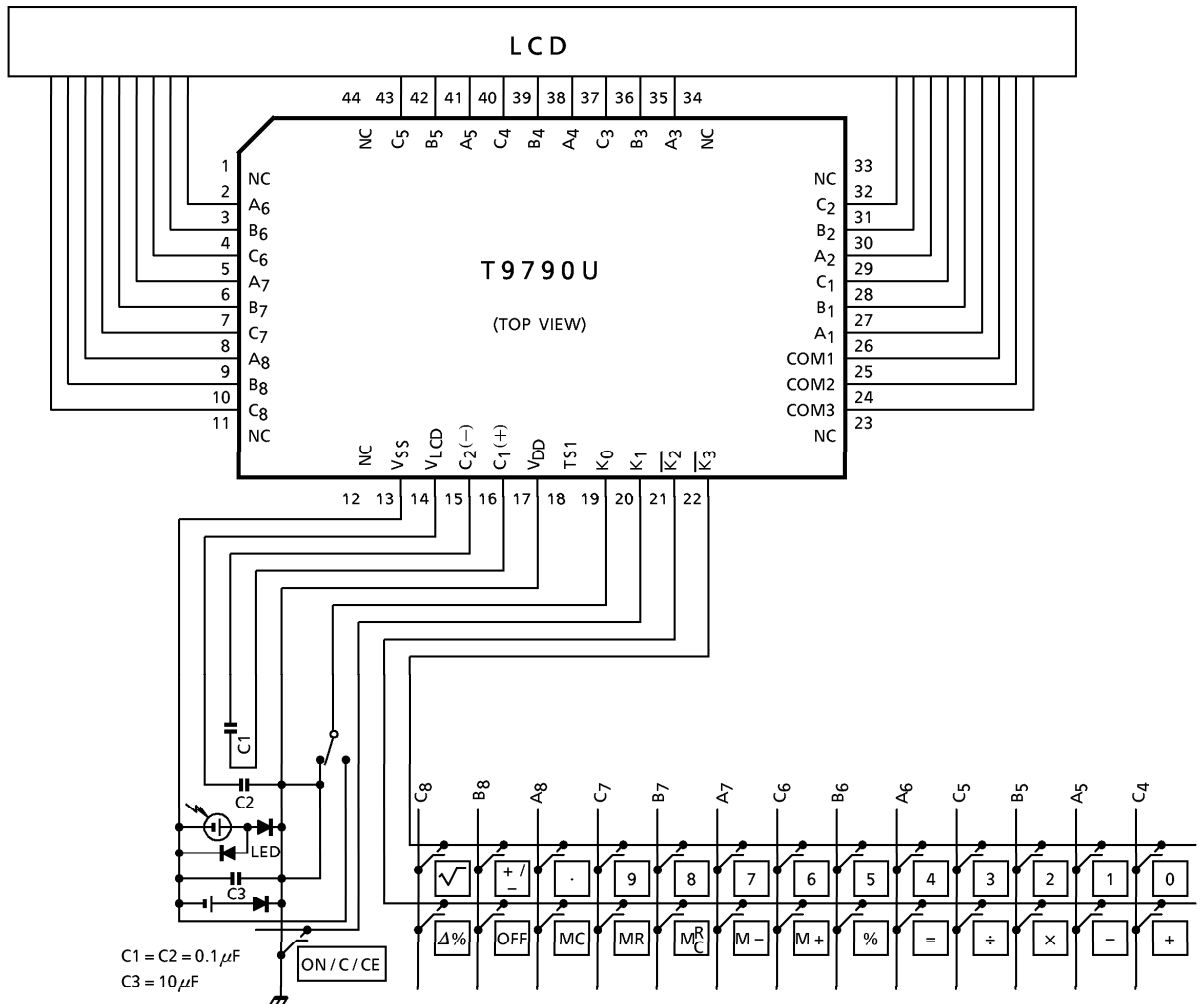
Battery Type



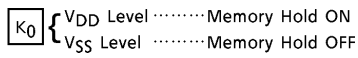
NOTE

INPUT capacity ≤ 400 (pF) at V_{DD} = 1.4 (V)
Key resistance ≤ 3 (kΩ) at V_{DD} = 1.4 (V)

Dual Type



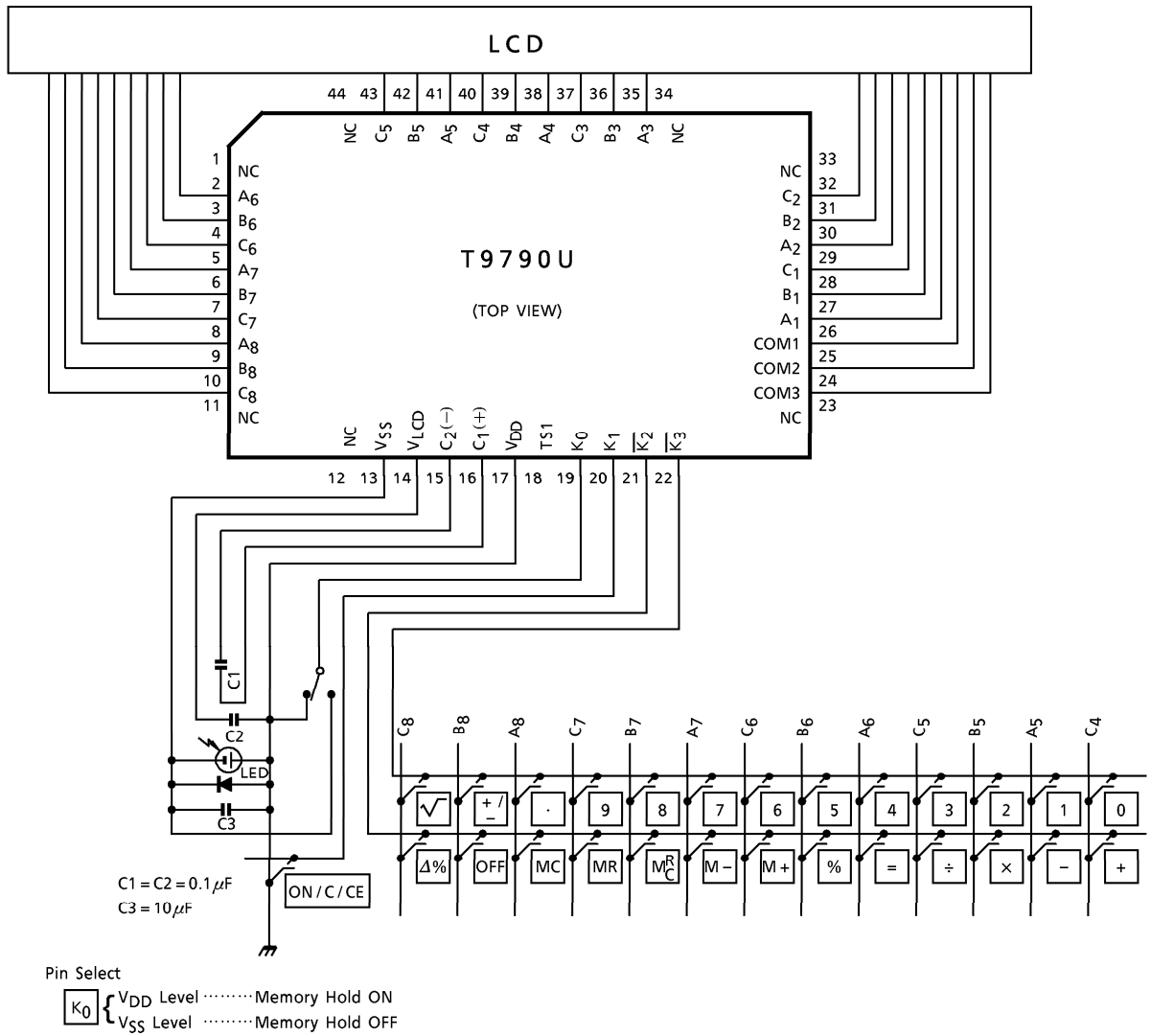
Pin Select



NOTE

INPUT capacity ≤ 400 (pF) at V_{DD} = 1.4 (V)
 Key resistance ≤ 3 (kΩ) at V_{DD} = 1.4 (V)

Solar Type

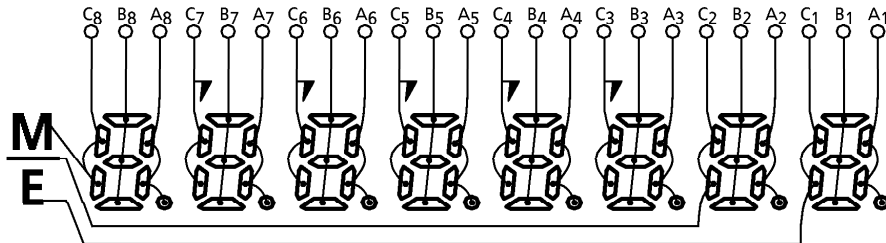


NOTE

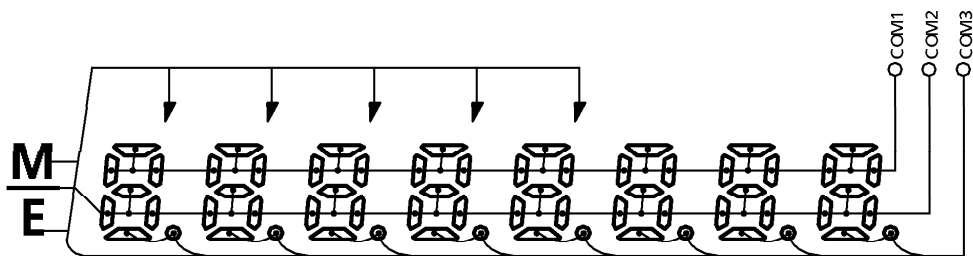
INPUT capacity ≤ 400 (pF) at $V_{DD} = 1.4$ (V)
 Key resistance ≤ 3 (kΩ) at $V_{DD} = 1.4$ (V)

CONNECTION OF LCD

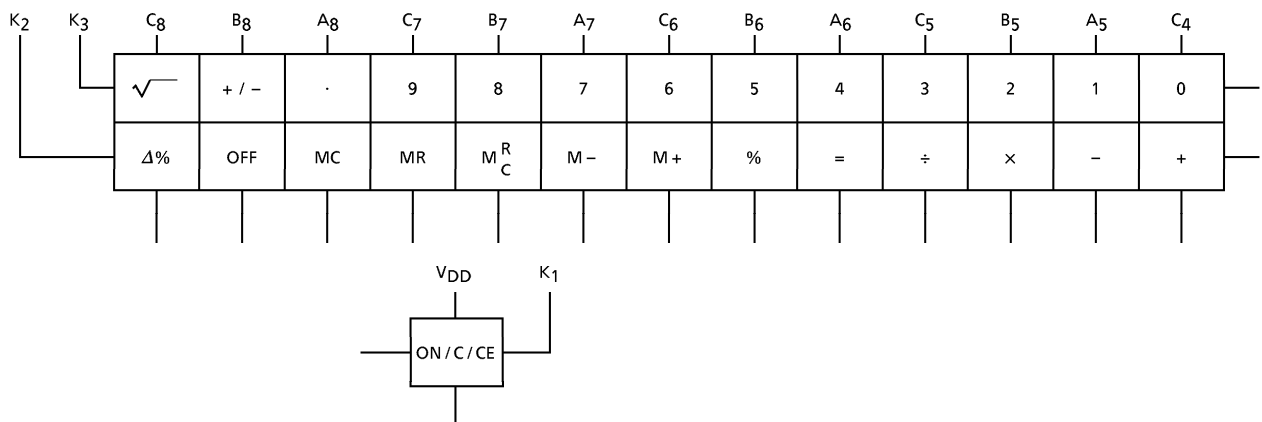
SEGMENT



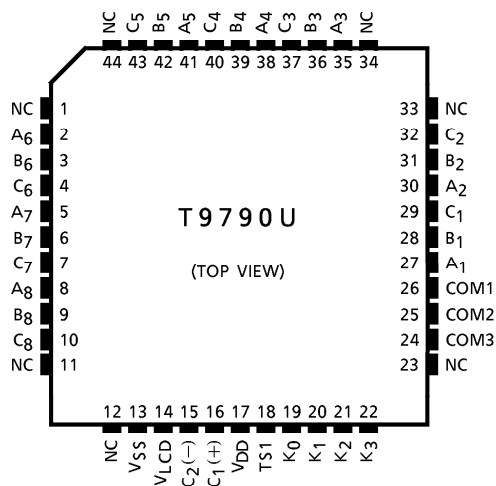
COMMON



KEY LAYOUT



PIN LAYOUT



SPECIFICATION OF CALCULATOR

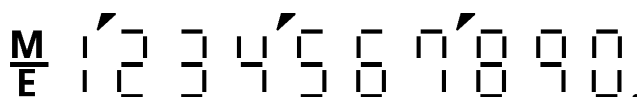
Operational Features

- (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_C^R** 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
	$\boxed{+}$	$A \cdot B$
	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 ²
(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
	$\boxed{\times}$	A
	B	B
	$\boxed{\%}$	$A \cdot B / 100$
	$\boxed{-}$	$A \cdot B / 100$
	$\boxed{=}$	$A - A \cdot B / 100$
(5)	A	A
	$\boxed{+}$	A
	B	B
	$\boxed{\%}$	$A + AB / 100$
(6)	A	A
	$\boxed{-}$	A
	B	B
	$\boxed{\%}$	$A - AB / 100$

9. Memory calculation

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

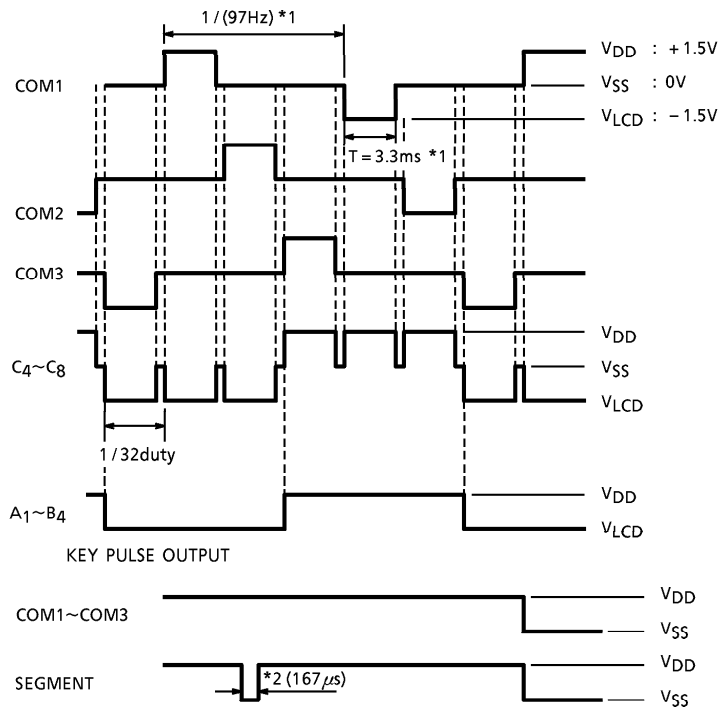
PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V _{DD}	- 0.3~ + 2.1	V
Input Voltage	V _{IN}	- 0.3~V _{DD} + 0.3	V
Operating Temperature	T _{opr}	0~40	°C
Storage Temperature	T _{stg}	- 55~125	°C

ELECTRICAL CHARACTERISTICS (V_{DD} = 1.4V ± 0.2V, V_{SS} = 0V, Ta = 25°C)

PARAMETER	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT		
Operating Voltage	V _{DD}	—	—	—	1.1	1.4	1.9	V		
"1" Input Voltage	V _{IH}	—	K ₁ ~K ₃	—	V _{DD} - 0.4	—	V _{DD}	V		
"0" Input Voltage	V _{IL}	—	K ₁ ~K ₃	—	0	—	0.4	V		
"1" Output Voltage	V _{OH}	—	Segment Common	—	V _{DD} - 0.2	—	V _{DD}	V		
"0" Output Voltage	V _{OL}	—	Segment Common	—	V _{DD} + 0.2	—	-V _{DD}	V		
"1" Output Voltage	V _{OH}	—	K ₂ ~K ₃	—	V _{DD} - 0.2	—	V _{DD}	V		
"0" Output Voltage	V _{OL}	—	K ₁	—	0	—	0.2	V		
"M" Output Voltage	V _{OM}	—	Common	—	V _{SS} + 0.2	—	V _{SS} - 0.2	V		
Output Resistance	"1"	R _{OH}	—	Segment	V _{OUT} = V _{DD} - 0.5V Key Strobe		70	kΩ		
	"0"	R _{OL}	—	Segment	V _{OUT} = V _{LCD} + 0.5V		70			
	"1"	R _{OH}	—	Common	V _{OUT} = V _{DD} - 0.5V		70			
	"0"	R _{OL}	—	Common	V _{OUT} = V _{LCD} + 0.5V		70			
Output Resistance	"M"	R _{OM}	—	Common	V _{OUT} = V _{SS} + 0.5V		10	kΩ		
Key Pull Down Resistance	R pull down	—	K ₁	V _{OUT} = V _{DD}	45	80	240	kΩ		
Key Pull up Resistance	R pull up	—	K ₂ ~K ₃	V _{OUT} = 0V	45	80	240	kΩ		
"0" Output Resistance	R _{KEY}	—	Segment	V _{OUT} = V _{SS} + 0.5V Key Strobe	—	—	10	kΩ		
Input Leakage Current	I _{IL}	—	K ₀	0 ≤ V _{IN} ≤ V _{DD}	—	—	± 1.0	μA		
Current Consumption (Wait)	I _{DD1}	—	—	V _{DD} = 1.4V (Key Open)	—	1.9	3.3	μA		
Current Consumption (OP)	I _{DD2}	—	—	V _{DD} = 1.1V (ALL 9√ Peak)	—	3.0	4.0	μA		
Current Consumption (OFF)	I _{DD OFF}	—	—	V _{DD} = 1.4V	—	—	1.0	μA		
Oscillating Frequency	f _φ (Wait)	—	—	V _{DD} = 1.4V	f _φ (Typ.) = Wait		4.2	7	9.8	kHz
	f _φ (OP)	—	—		f _φ (Typ.) = Operate		10.8	18	25.2	
Frame Frequency	f _F	—	—	V _{DD} = 1.4V (Wait)	58	97	136	Hz		
Power off Timer	Timer	—	—	V _{DD} = 1.4V	300	420	700	s		

WAVEFORMS FOR DISPLAY

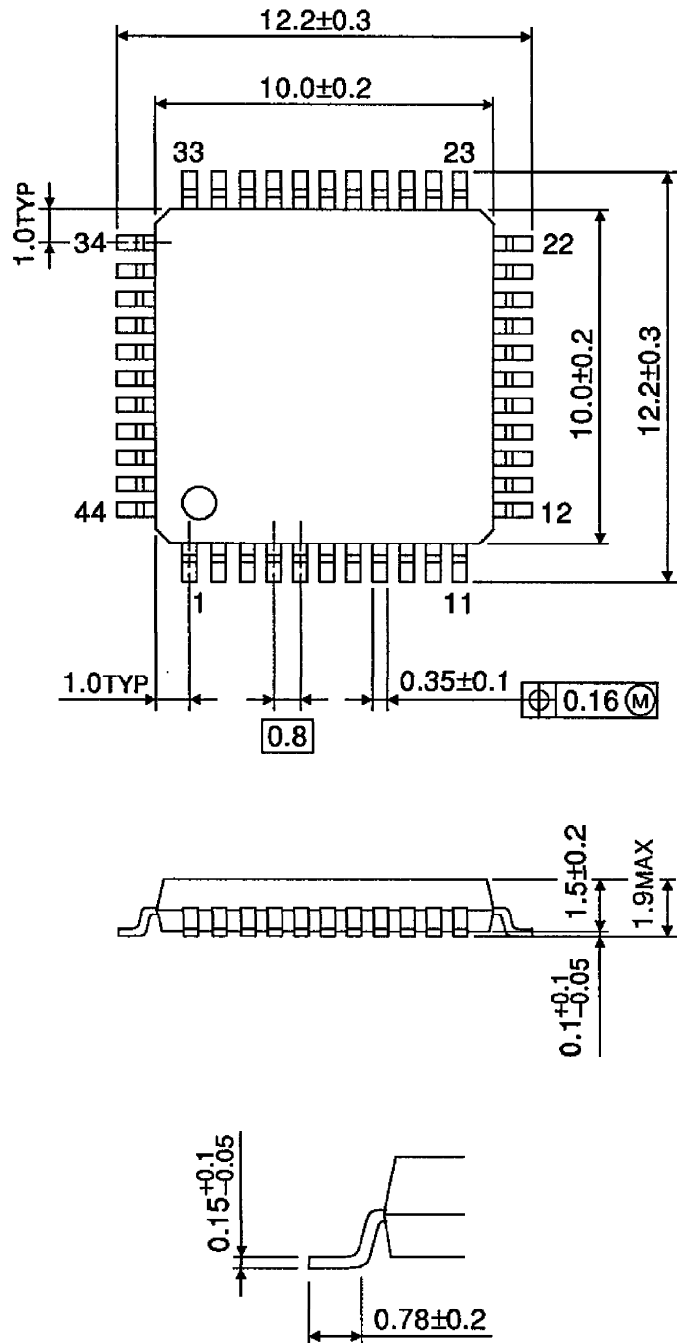
Display Device : FEM type LCD 3.0V, 1/2 bias, 1/3 duty dynamic system



(*1) $f_{\phi} = 7\text{kHz}$
 (*2) $f_{\phi} = 18\text{kHz}$

OUTLINE DRAWING
QFP44-P-1010-0.80

Unit : mm



Weight : 0.34g (Typ.)