

T9790U

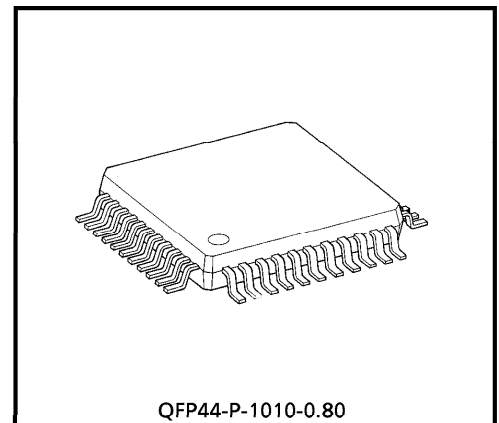
T9790U CMOS SINGLE-CHIP LSI FOR LCD CALCULATOR

The T9790U is a single-chip microcomputer for 8-digit 1-memory 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

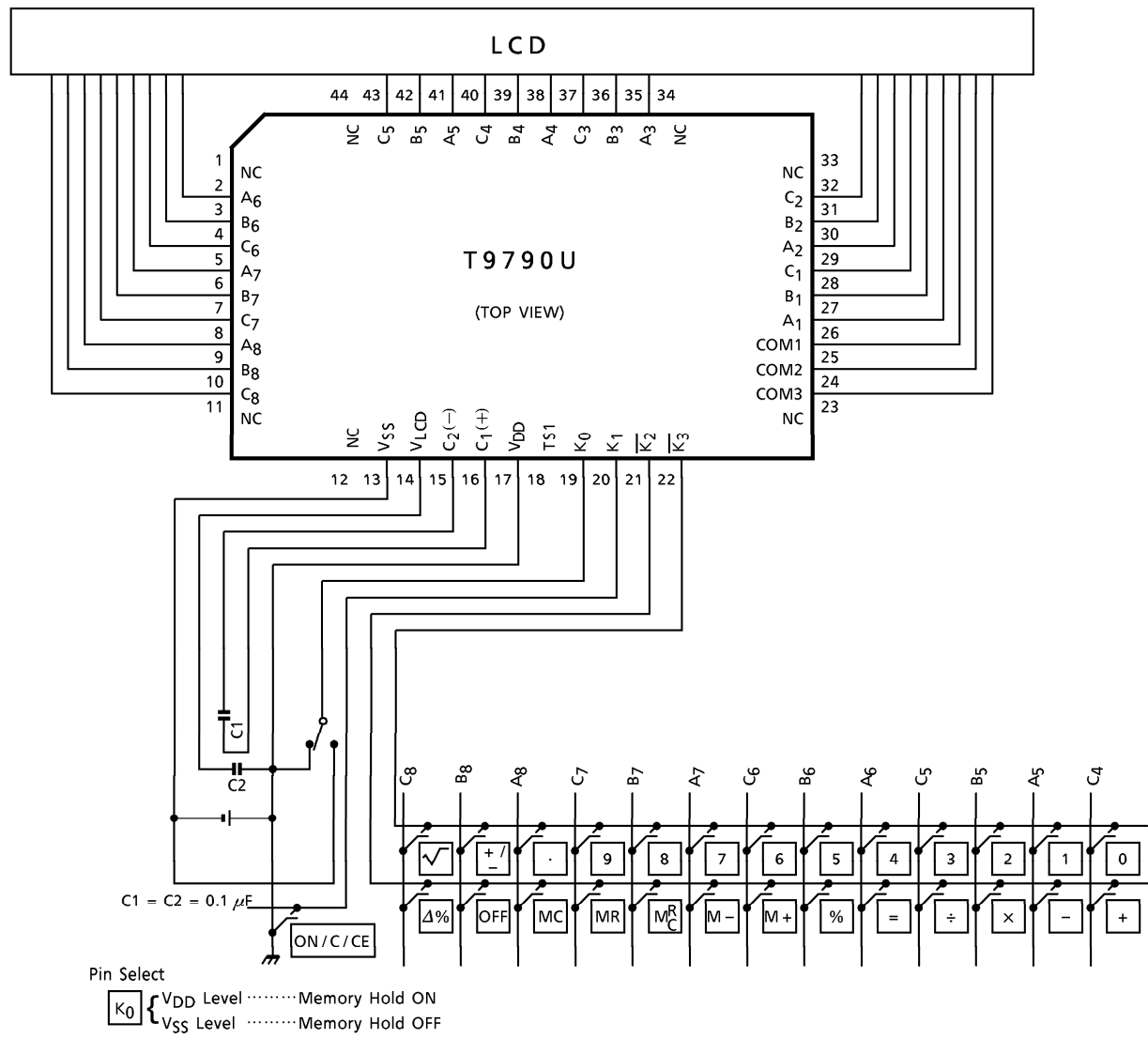
- 8 digits of data and 1 symbol digit for calculator.
- Algebraic calculation mode.
- Punctuation.
- Standard 4 functions (+, -, ×, ÷), mark up percent with automatic add-on/discount, automatic constant calculations, chain calculations, memory calculations with memory overflow protection.
- Internal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



QFP44-P-1010-0.80
Weight : 0.34 g (Typ.)

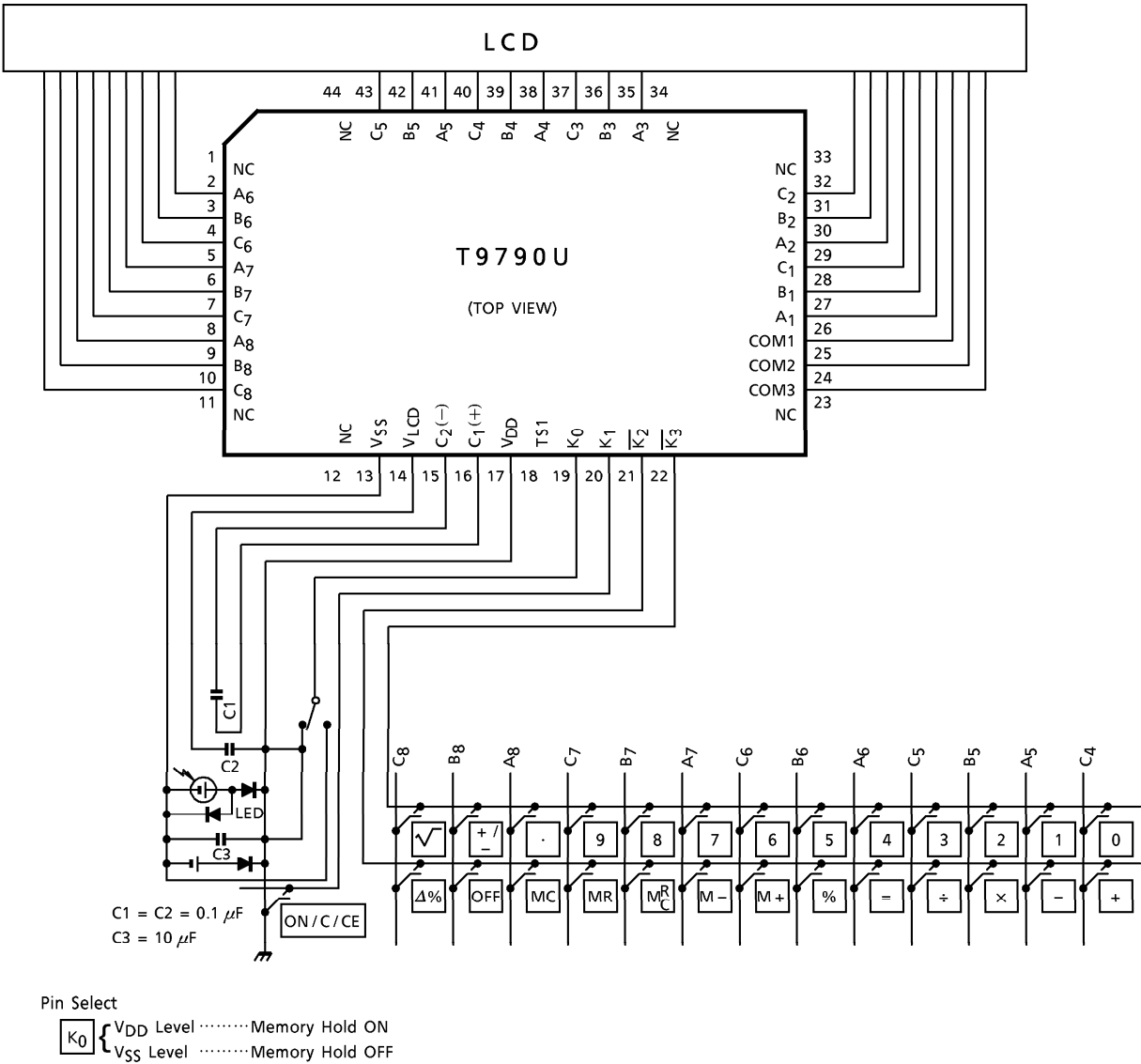
SYSTEM BLOCK DIAGRAM

Battery Type



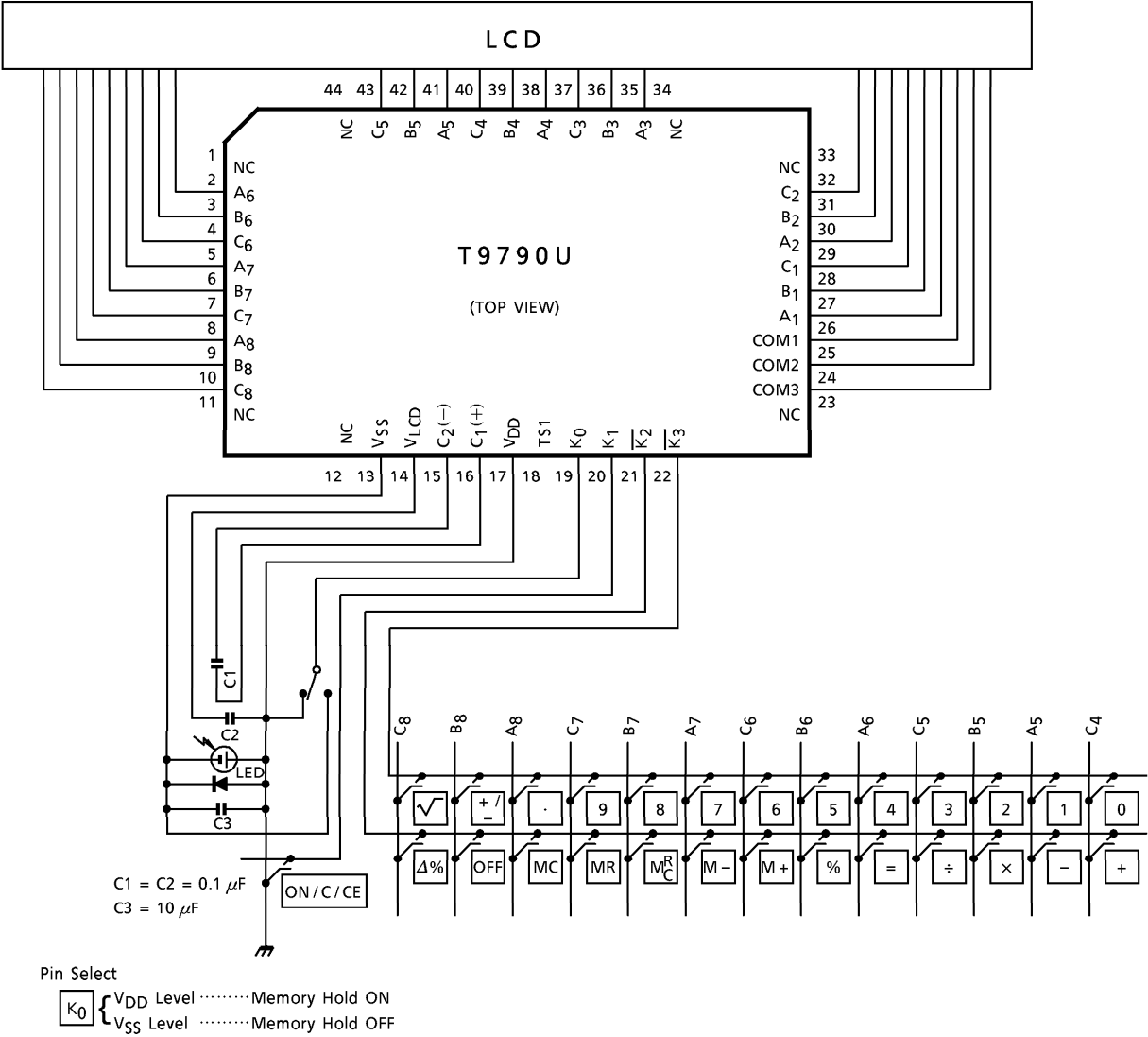
(Note) : INPUT capacity ≤ 400 (pF) at V_{DD} = 1.4 (V)
Key resistance ≤ 3 (kΩ) at V_{DD} = 1.4 (V)

Dual Type



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

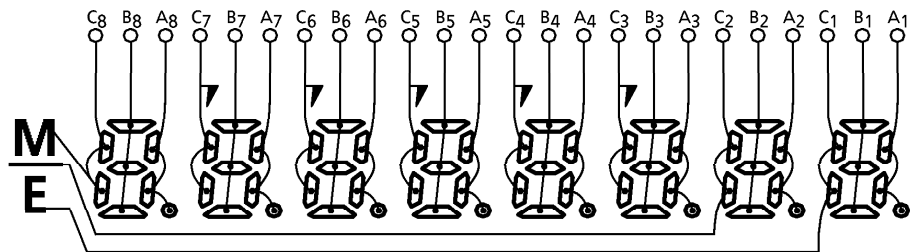
Solar Type



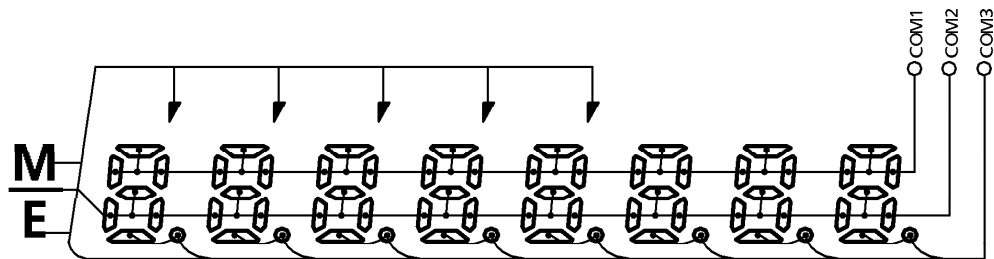
(Note) : INPUT capacity ≤ 400 (pF) at $V_{DD} = 1.4$ (V)
Key resistance ≤ 3 (k Ω) at $V_{DD} = 1.4$ (V)

CONNECTION OF LCD

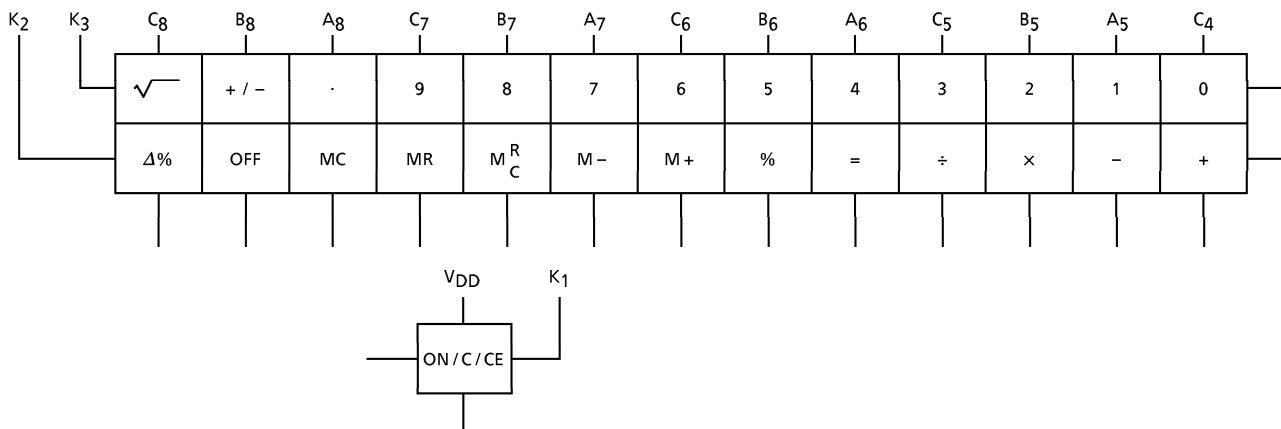
SEGMENT



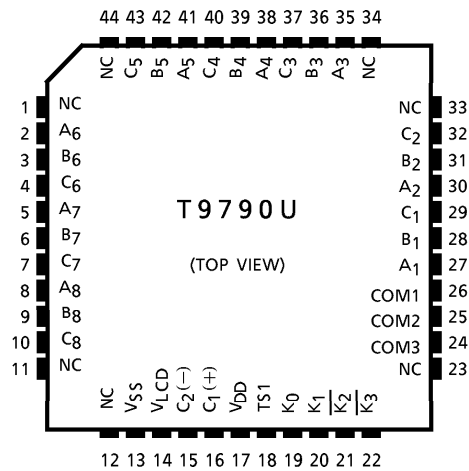
COMMON



KEY CONNECTION



PIN CONNECTION



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

The display font shows the memory indicator 'M' over 'E' on the left, followed by digits 1 through 9, and a decimal point. Each digit has a small apostrophe-like mark above it, likely indicating a shift register or similar feature.

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

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
	+ / -	- D
	-	A - B - C + D
	=	- (A - B - C + D)

3. Multiplication

(1)	A	A
	×	A
	B	B
	=	A·B
	+	A·B
	C	C
	=	A·B + C
(2)	-	0.
	A	A
	×	- A
	B	B
	=	- A·B

4. Division

(1)	A	A
	÷	A
	B	B
	=	A / B
(2)	-	0.
	A	A.
	÷	- A
	B	B
	=	- A / B

5. Power calculation

(1)	A	A
	×	A

	Key Op.	Display
	=	A^2
	=	A^3
(2)	A	A
	÷	A
	=	$1 / A$
	=	$1 / A^2$
(3)	-	0.
	A	A
	×	- A
	=	A^2
	=	- A^3
(4)	-	0.
	A	A
	÷	- A
	=	- $1 / A$
	=	$1 / A^2$
(5)	A	A
	×	A
	=	A^2
	×	A^2
	=	A^4
6. Mixed calculation		
(1)	A	A
	×	A
	B	B
	+	$A \cdot B$
	C	C
	÷	$A \cdot B + C$
	D	D

7. Constant calculation

	Key Op.	Display
	-	$\frac{A \cdot B + C}{D}$
	E	E
	=	$\frac{A \cdot B + C}{D} - E$
(1)	A	A
	×	A
	B	B
	=	A · B
	C	C
	=	A · C
(2)	-	0.
	A	A
	×	- A
	B	B
	=	- A · B
	C	C
	=	- A · C
(3)	A	A
	÷	A
	B	B
	=	A / B
	C	C
	=	C / B
	D	D
	×	D
	=	D ²
(4)	A	A
	+	A
	B	B

	Key Op.	Display
(5)	=	A + B
	C	C
	=	C + B
	A	A
	-	A
	B	B
	=	A - B
	C	C
	=	C - B
	A	A
(6)	×	A
	B	B
	=	A·B
	C	C
	×	C
	D	D
	=	C·D
	E	E
	=	C·E
	×	C·E
	F	F
	=	C·E·F
	G	G
	÷	G
	H	H
	=	G / H
	I	I
	=	I / H

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

8. Mark-up / Discount calculator

(1)	A	A
	×	A
	B	B
	+	$A \cdot B$
	=	$A + A \cdot B$
(2)	A	A
	×	A
	B	B
	-	$A \cdot B$
	=	$A - A \cdot B$
(3)	A	A
	×	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
	$\boxed{M_C^R}$ or $\boxed{MR}$	A + B - C (M)	A + B - C
	$\boxed{M_C^R}$ 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_C^R 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. (M_E)	1.0000001
	$ON / C / CE$	0. (M)	1.0000001
	M_C^R or MR	1.0000001 (M)	1.0000001

10.Square root

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

	Key Op.	Display	Memory
(5)	A	A	0.
	$M+$	A (M)	A
	M_C^R or MR	A (M)	A
	$\div$	A (M)	A
	B	B (M)	A
	$+/-$	- B (M)	A
	$\sqrt{}$	$\sqrt{B} (M_E)$	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.
	×	A	0.
	÷	A	0.
	−	A	0.
	+	A	0.
	√	$\sqrt{A}$	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.
	×	B	0.
	÷	B	0.
	=	1 / B	0.
13.Others			
(1)	A	A	
	+	A	
	=	A	
(2)	A	A	
	×	A	
	÷	A	
	=	1 / A	
(3)	A	A	
	÷	A	

	Key Op.	Display	Memory
	+	A	
	=	A	
(4)	A	A	
	×	A	
	−	A	
	=	− A	
(5)	A	A	
	÷	A	
	−	A	
	=	− A	
(6)	A	A	
	×	A	
	ON / C / CE	0.	
	B	B	
	=	B	
(7)	A	A	
	×	A	
	B	B	
	ON / C / CE	0.	
	C	C	
	=	A·C	

14.Delta Percentage key function

(1)	A	A	
	+	A	
	B	B	
	Δ%	(A + B) / B·100	
(2)	A	A	
	÷	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 6.2~9.5 ms, after key input ($f\phi$ typ.)
- (2) At time of key off : about 30.8 ms, 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

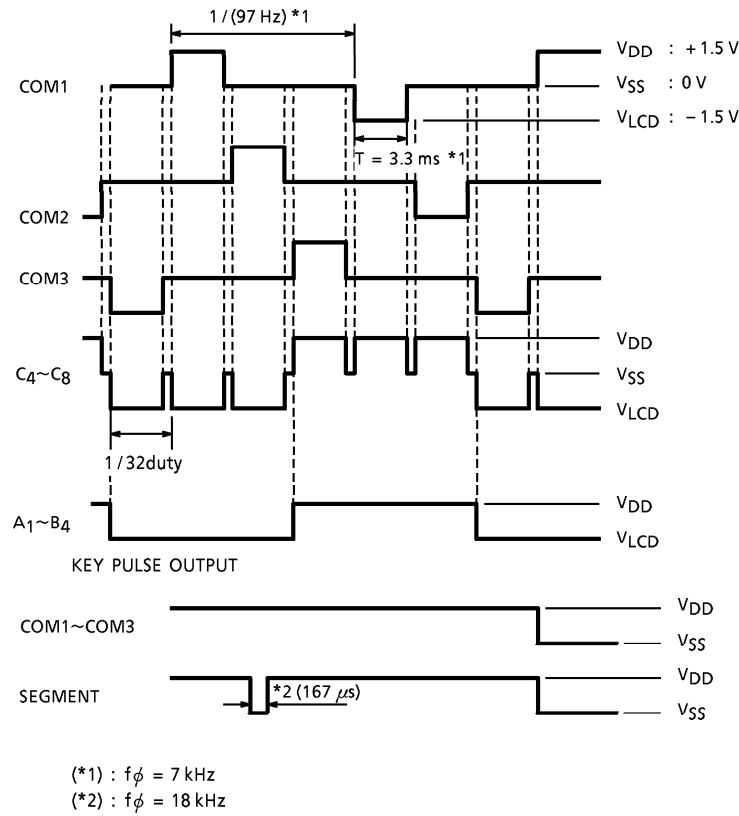
CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	$-0.3 \sim +2.1$	V
Input Voltage	V_{IN}	$-0.3 \sim V_{DD} + 0.3$	V
Operating Temperature	T_{opr}	$0 \sim 40$	°C
Storage Temperature	T_{stg}	$-55 \sim 125$	°C

ELECTRICAL CHARACTERISTICS ($V_{DD} = 1.4 \text{ V} \pm 0.2 \text{ V}$, $V_{SS} = 0 \text{ V}$, $T_a = 25^\circ\text{C}$)

CHARACTERISTICS		SYMBOL	TEST CIRCUIT	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} - 0.5 V Key Strobe	—	—	70	kΩ	
	"0"	R _{OL}	—	Segment	V _{OUT} = V _{LCD} + 0.5 V	—	—	70		
	"1"	R _{OH}	—	Common	V _{OUT} = V _{DD} - 0.5 V	—	—	70		
	"0"	R _{OL}	—	Common	V _{OUT} = V _{LCD} + 0.5 V	—	—	70		
Output Resistance	"M"	R _{OM}	—	Common	V _{OUT} = V _{SS} + 0.5 V	—	—	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} = 0 V	45	80	240	kΩ	
"0" Output Resistance		R _{KEY}	—	Segment	V _{OUT} = V _{SS} + 0.5 V 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} = 1.4 V (Key Open)	—	1.9	3.3	μA	
Current Consumption (OP)		I _{DD2}	—	—	V _{DD} = 1.1 V (ALL 9 √Peak)	—	3.0	4.0	μA	
Current Consumption (OFF)		I _{DD OFF}	—	—	V _{DD} = 1.4 V	—	—	1.0	μA	
Oscillating Frequency		fφ (Wait)	—	—	V _{DD}	fφ (Typ.) = Wait	4.2	7	9.8	kHz
		= 1.4 V			fφ (Typ.) = Operate	10.8	18	25.2		
Frame Frequency		f _F	—	—	V _{DD} = 1.4 V (Wait)	58	97	136	Hz	
Power off Timer		Timer	—	—	V _{DD} = 1.4 V	300	420	700	s	

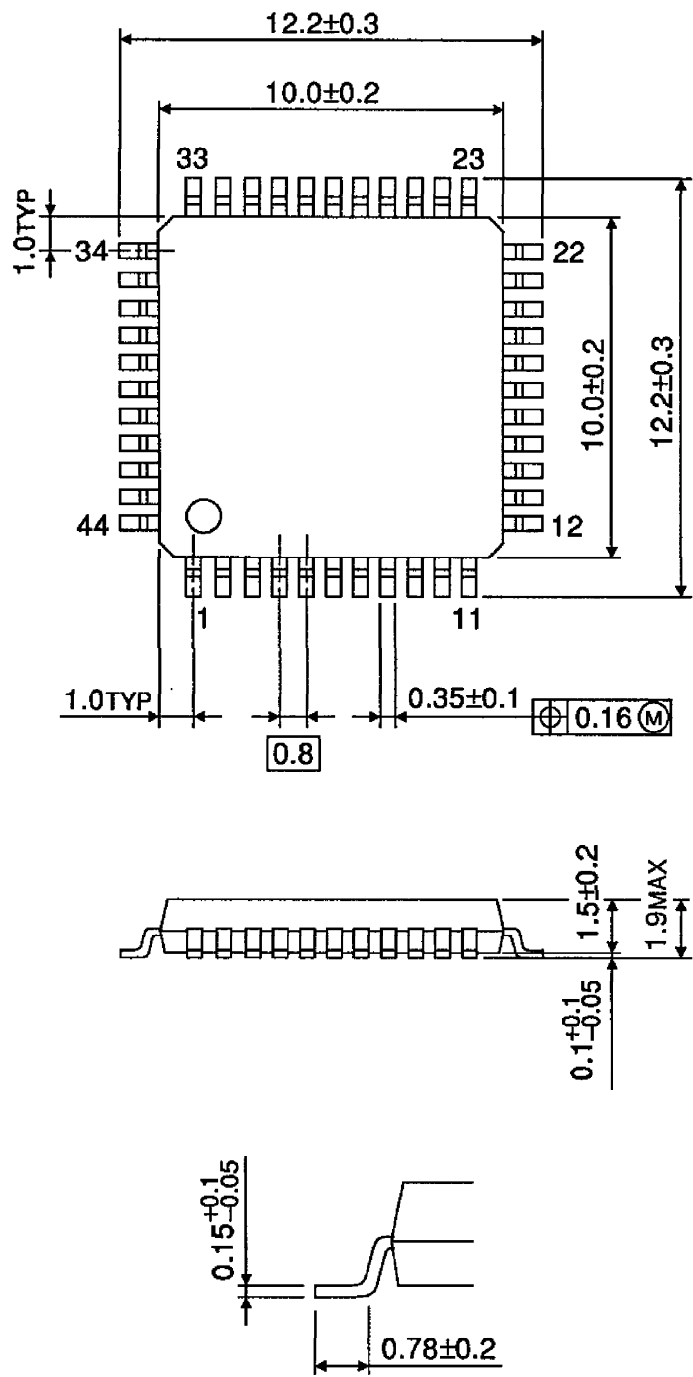
WAVEFORMS FOR DISPLAY

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



PACKAGE DIMENSIONS
QFP44-P-1010-0.80

Unit : mm



Weight : 0.34g (Typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

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