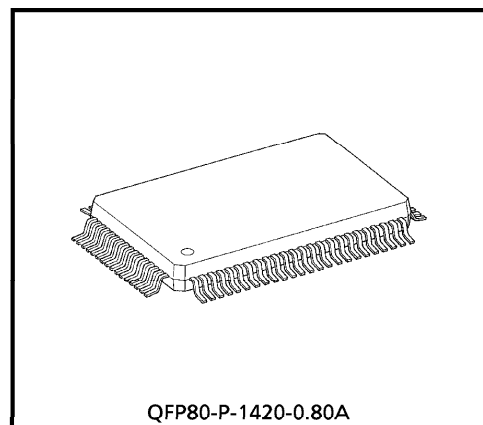


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T6M74A, JT6M74A-AS

T6M74A, JT6M74A-AS CMOS SINGLE-CHIP LSI FOR LCD CALCULATOR

The T6M74A, JT6M74A-AS is a CMOS single-chip microcomputer for 16-digit 1-memory calculator. T6M74A, JT6M74A-AS is the complete single-chip CMOS LSI for calculator with single power supply operation. Wide operating voltage range and low-power consumption make it suitable for 1.5 V solar battery operated. Besides T6M74A, JT6M74A-AS can selectable with a pin-programmable to function of Power timer and Memory hold. With the following features.



Weight : 1.52 g (Typ.)

FEATURES

- Display : 16 digits of data, 1 digit of sign, error symbol, memory load symbol.
- Algebraic mode.
- Standard 4 functions (+, -, ×, ÷)
- Automatic percentage operation with add-on, discount.
- Automatic delta percentage, mark-up and markdown operations.
- Square root.
- Constant calculation.
- Chain calculation.
- Change sign.
- Floating point or momentary mode (selectable with a switch).
- Fixed point ("0", "1", "2", "3", "4" or "6" places) or floating point (selectable with a switch).
- Adding point mode (selectable with a switch).

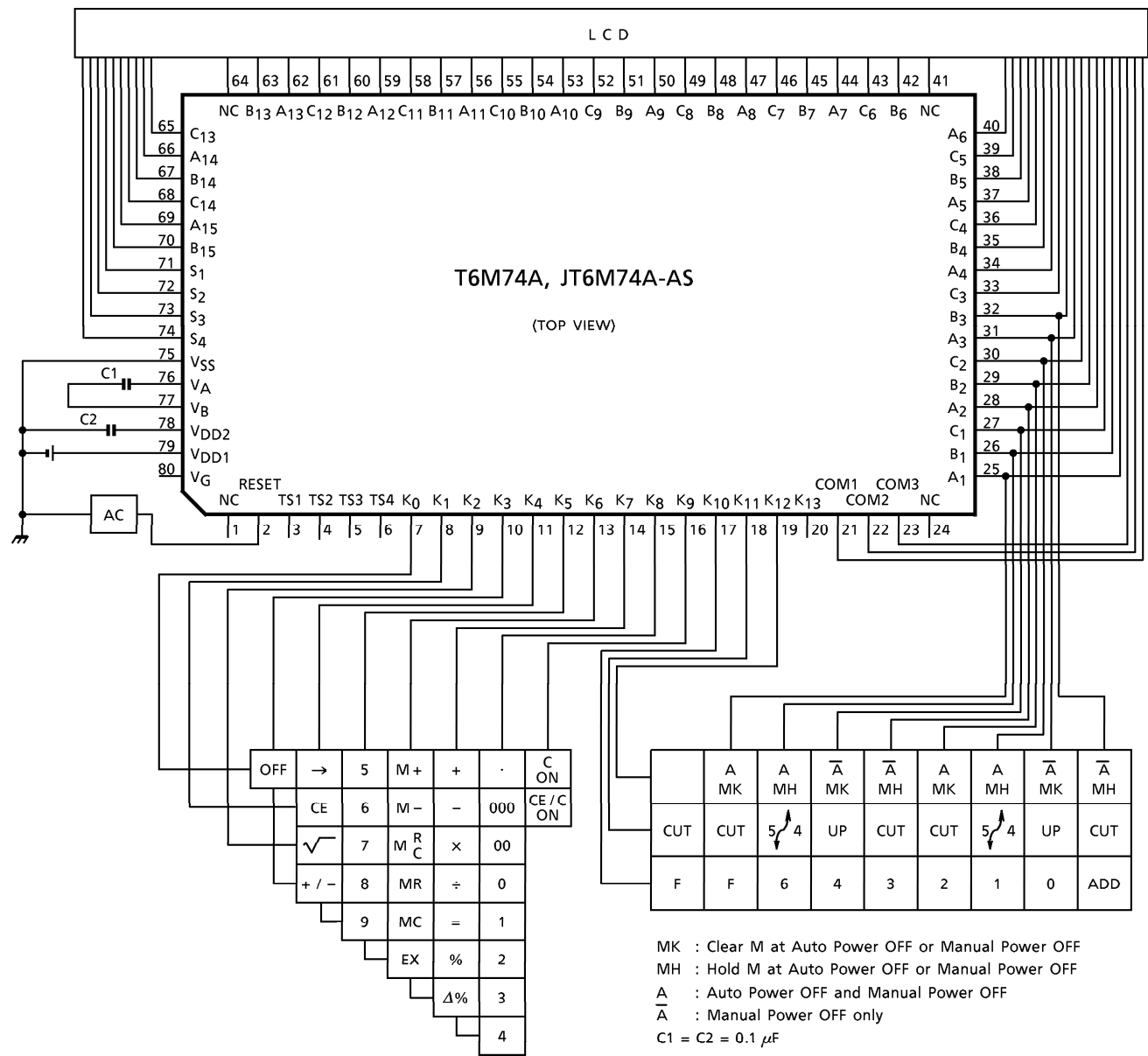
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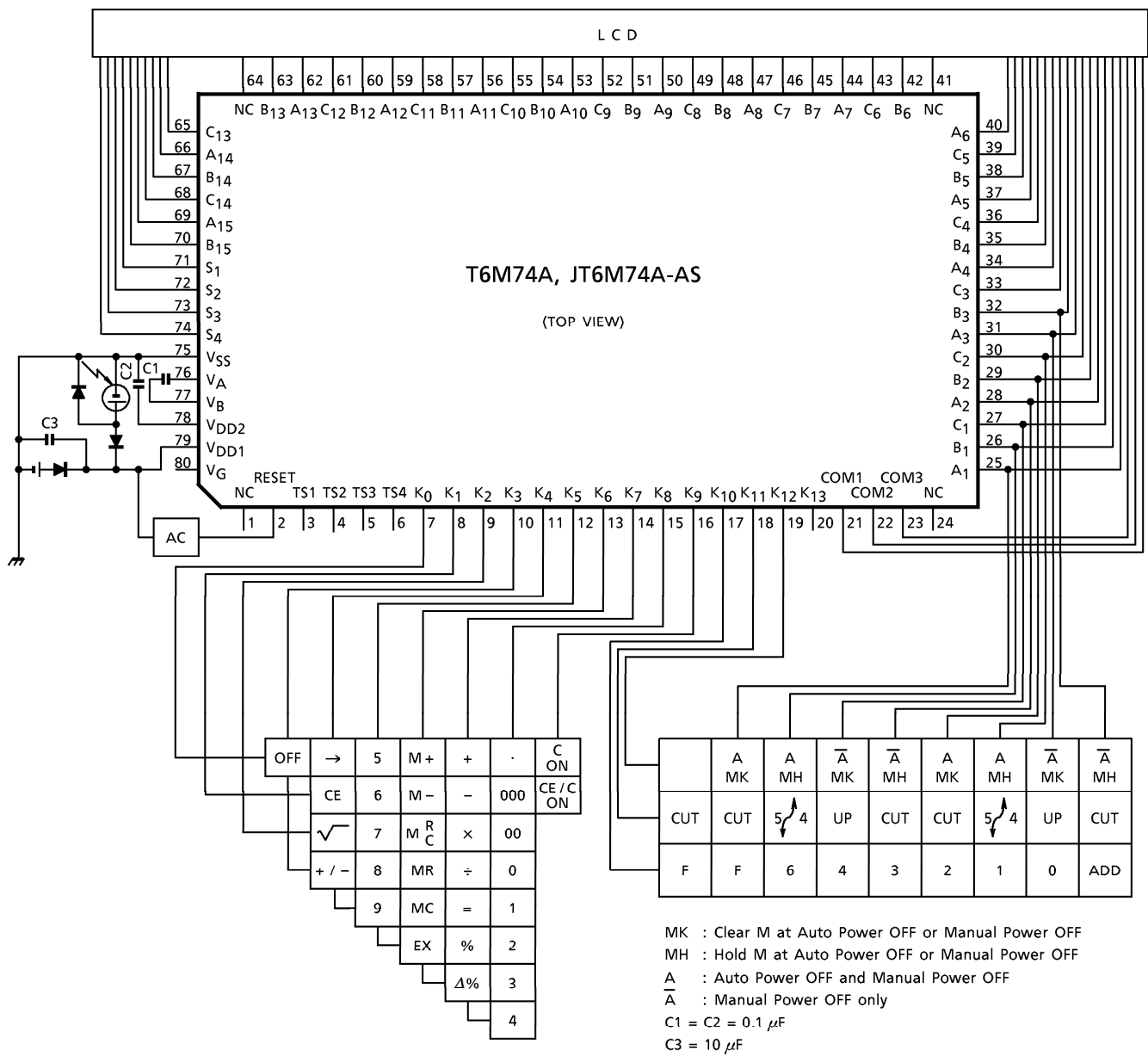
- Rounding switches (rounding up, down and off).
- Leading zero suppression.
- Trailing zero suppression.
- Punctuation on display, commas for thousands.
- Memory contents indicator, turned on with non-zero in the memory.
- Registration overflow, indicating that too many digits are entered (the most significant digit are protected).
- Result overflow, indicating during calculation (most function key are locked as it happened).
- Memory overflow indicating to flashing of memory load mark.
- Key roll over function.
- Floating minus.

SYSTEM BLOCK DIAGRAM

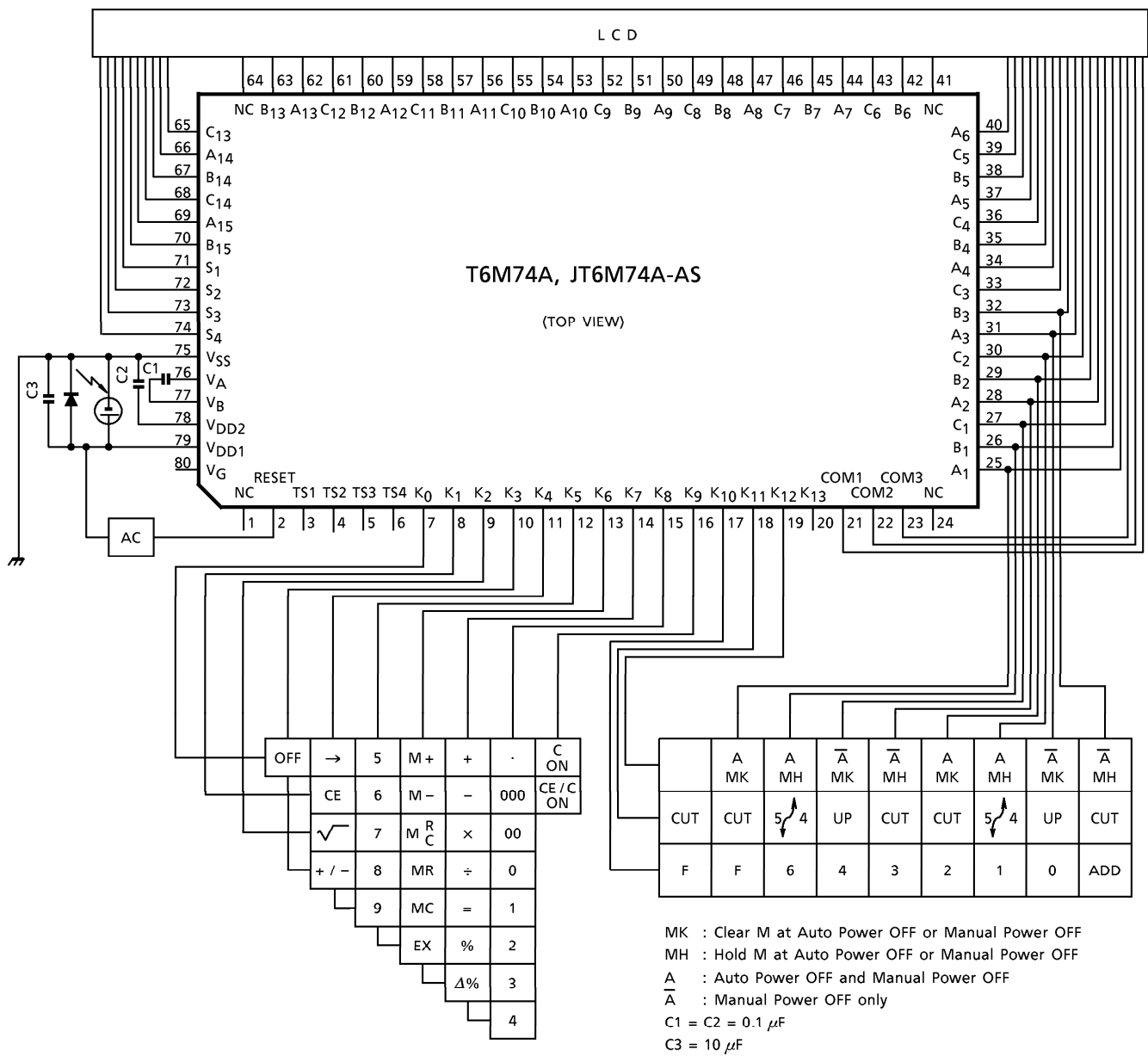
Battery Type



Dual Type

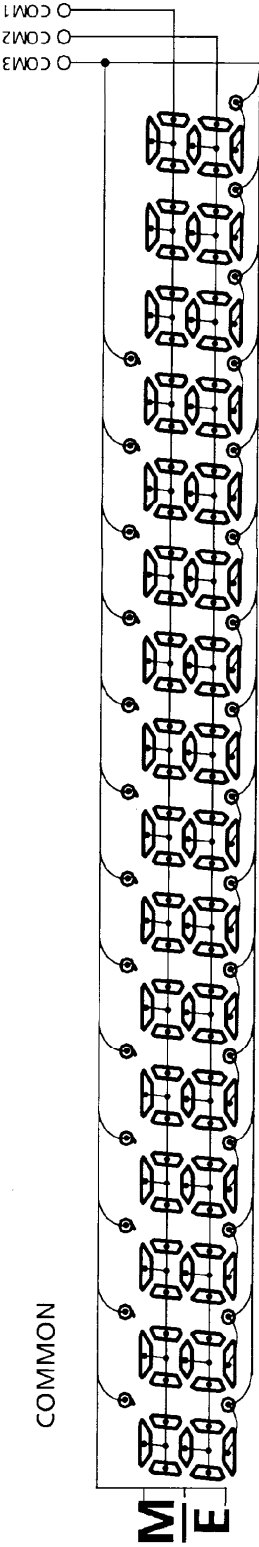
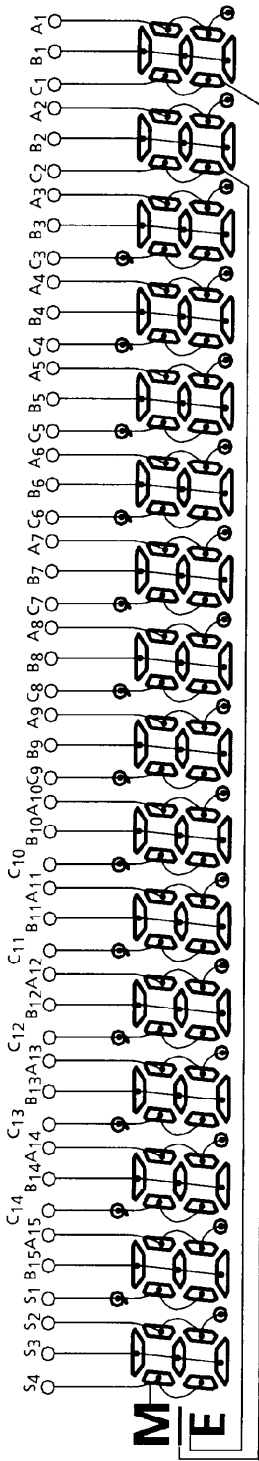


Solar Type



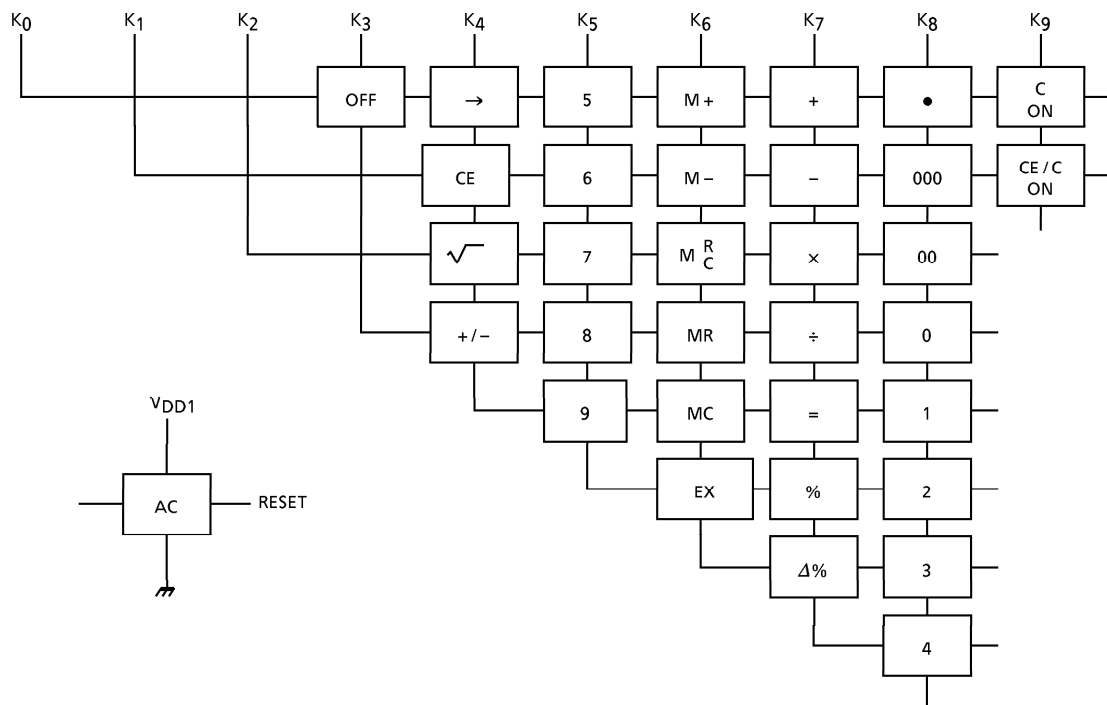
CONNECTION OF LCD

SEGMENT

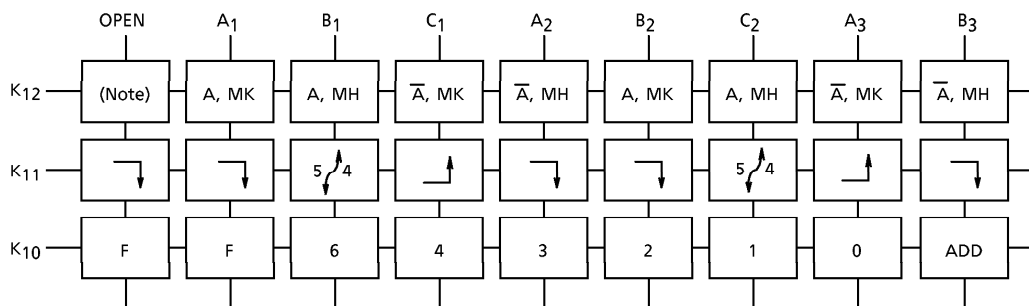


T6M74A, JT6M74A-AS-06

KEY CONNECTION



Touch Key



Lock Key

K₁₂ Selectable with Auto Power OFF mode an Memory Hold Status.
MH (Memory Hold), MK (Memory Kill)

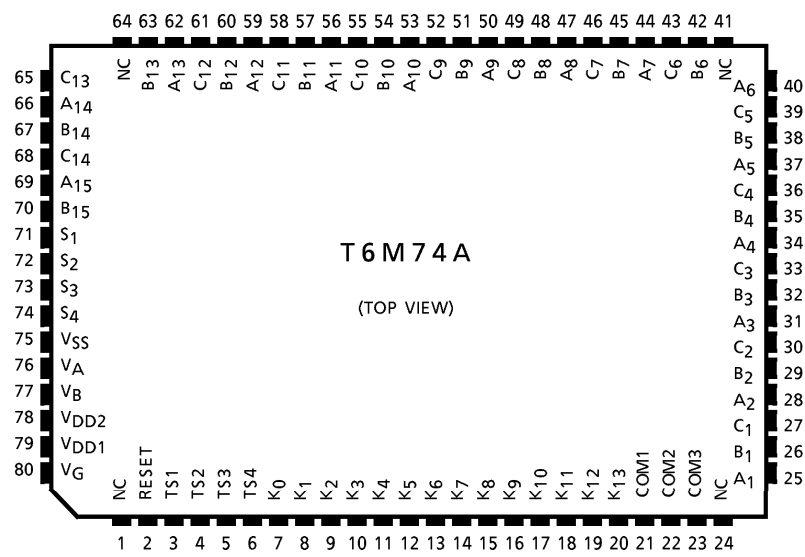
K₁₁ Rounding

K₁₀ Selectable with Fixed point or Floating mode.

(Note) : K₁₂ line is No choose then keep condition.

K₁₂ line is No choose at the system power on then initial condition is A, MH Mode selected.

PIN ASSIGNMENT



SPECIFICATION OF CALCULATOR

Speed of calculation

Numeral		27.8~40.9 ms
Function	$\left\{ \begin{array}{l} 1 \text{ [+]} \dots\dots\dots \\ 1 \text{ [+] } 2 \text{ [+]} \dots\dots\dots \end{array} \right.$	$\left\{ \begin{array}{l} 42.7 \text{ ms} \\ 83.9 \text{ ms} \end{array} \right.$
Addition and subtract	$\left\{ \begin{array}{l} 123 \text{ [+] } 1 \text{ [=]} \dots\dots\dots \\ 9999999999999999 \text{ [-] } 0.0000000000000001 \text{ [=]} \dots\dots\dots \end{array} \right.$	$\left\{ \begin{array}{l} 82.8 \text{ ms} \\ 106.4 \text{ ms} \end{array} \right.$
Multiply	$\left\{ \begin{array}{l} 123 \text{ [x] } 2 \text{ [=]} \dots\dots\dots \\ 1 \text{ [x] } 9999999999999999 \text{ [=]} \dots\dots\dots \end{array} \right.$	$\left\{ \begin{array}{l} 110.8 \text{ ms} \\ 309.9 \text{ ms} \end{array} \right.$
Device	$\left\{ \begin{array}{l} 123 \text{ [÷] } 3 \text{ [=]} \dots\dots\dots \\ 9999999999999999 \text{ [÷] } 1 \text{ [=]} \dots\dots\dots \end{array} \right.$	$\left\{ \begin{array}{l} 165.1 \text{ ms} \\ 348.4 \text{ ms} \end{array} \right.$
Memory calculation	$\left\{ \begin{array}{l} 2 \text{ [M +]} \dots\dots\dots \\ 9999999999999999 \text{ [÷] } 1 \text{ [M +]} \dots\dots\dots \end{array} \right.$	$\left\{ \begin{array}{l} 93.8 \text{ ms} \\ 388.1 \text{ ms} \end{array} \right.$
Square root	$\left\{ \begin{array}{l} 9999999999999999 \text{ [√]} \dots\dots\dots \\ 2 \text{ [√]} \dots\dots\dots \end{array} \right.$	$\left\{ \begin{array}{l} 259.7 \text{ ms} \\ 170.2 \text{ ms} \end{array} \right.$

Operation example

1. Fixed point calculations

① Key	Display	Fixed point place	② Key	Display	Fixed point place
C	0.	DP = 3 (5 / 4)	C	0.	DP = 0 (↱)
2	2.		1	1.	
÷	2.		·	1.	
3	3.		2	1.2	
=	0.667		3	1.23	
2	2.		+	1.23	
·	2.		1	1.	
3	2.3		·	1.	
+	2.3		1	1.1	
4	4.		=	3.	
M +	6.300		9	9.	
1	1.		√	3.	
·	1.		×	3.	
2	1.2		1	1.	
M +	1.200		·	1.	
MR	7.5	DP = 4	1	1.1	DP = F
			=	3.3	

2. Adding point mode calculations

Key	Display	Key	Display	Key	Display
$\boxed{C}$	0.	$\boxed{M+}$	0.02M	$\boxed{=}$	33.27M –
1	1.	3	3.M	2	2.M
23	123	$\boxed{\cdot}$	3.M	$\boxed{+}$	0.02M
$\boxed{+}$	1.23	123	3.123M	9	9.M
3	3.	$\boxed{M+}$	3.12M	$\boxed{\cdot}$	9.M
$\boxed{=}$	1.26	$\boxed{MR}$	3.14M	$\boxed{\sqrt{}}$	3.M
3	3.	$\boxed{C}$	0.M	$\boxed{=}$	3.02M
2	32.	1	1.M		
$\boxed{\times}$	32.	23	123M		
3	3.	$\boxed{-}$	1.23M		
$\boxed{\cdot}$	3.	3	3.M		
000	3.000	4	34.M		
$\boxed{=}$	96.00	$\boxed{\cdot}$	34.M		
2	2.	5	34.5M		

3. Constant calculations

① Multiplication

Key	Display	Constant
k	k	
$\boxed{\times}$	k	
a	a	
$\boxed{=}$	k·a	k ×
b	b	k ×
$\boxed{=}$	k·b	k ×

③ Addition

a	a	
$\boxed{+}$	a	
k	k	
$\boxed{=}$	a + k	+ k
b	b	+ k
$\boxed{=}$	b + k	+ k

② Division

Key	Display	Constant
a	a	
$\boxed{\div}$	a	
k	k	
$\boxed{=}$	a / k	÷ k
b	b	÷ k
$\boxed{=}$	b / k	÷ k

④ Subtraction

a	a	
$\boxed{-}$	a	
k	k	
$\boxed{=}$	a – k	– k
b	b	– k
$\boxed{=}$	b – k	– k

⑤ Percentage

Key	Display	Constant
k	k	
$\boxed{\times}$	k	
a	a	
$\boxed{\%}$	$k \cdot a / 100$	$k \times$
b	b	$k \times$
$\boxed{\%}$	$k \cdot b / 100$	$k \times$

⑦ Add-on

k	k	
$\boxed{+}$	k	
a	a	
$\boxed{\%}$	$k \cdot (1 + a / 100)$	$k +$
b	b	$k +$
$\boxed{\%}$	$k \cdot (1 + b / 100)$	$k +$

4. $\Delta\%$ calculations

① Key Display

a	a
$\boxed{+}$	a
b	b
$\boxed{\Delta\%}$	$100 \cdot (a + b) / b$

5. Mark-up, mark-down calculations

① Mark-up

Key	Display
a	a
$\boxed{\div}$	a
b	b
$\boxed{\Delta\%}$	$a / (1 - b / 100)$
$\boxed{\Delta\%}$	$ a / (1 - b / 100) $

⑥ Percentage

Key	Display	Constant
a	a	
$\boxed{\div}$	a	
k	k	
$\boxed{\%}$	$100 \cdot a / k$	$\div k$
b	b	$\div k$
$\boxed{\%}$	$100 \cdot b / k$	$\div k$

⑧ Discount

k	k	
$\boxed{-}$	k	
a	a	
$\boxed{\%}$	$k \cdot (1 - a / 100)$	$k -$
b	b	$k -$
$\boxed{\%}$	$k \cdot (1 - b / 100)$	$k -$

② Key Display

a	a
$\boxed{-}$	a
b	b
$\boxed{\Delta\%}$	$100 \cdot (a - b) / b$

② Mark-down

Key	Display
a	a
$\boxed{\div}$	a
b	b
$\boxed{+/-}$	-b
$\boxed{\Delta\%}$	$a / (1 + b / 100)$
$\boxed{\Delta\%}$	$a / (1 + b / 100) - a$

6. Add-on, discount calculations

Add-on

Key	Display
① a	a
$\times$	a
b	b
$\%$	$a \cdot b / 100$
$+$	$a \cdot b / 100$
$=$	$a (1 + b / 100)$
③ a	a
$+$	a
b	b
$\%$	$a (1 + b / 100)$
⑤ a	a
$\times$	a
b	b
$\Delta\%$	$a \cdot (1 + b / 100)$

Discount

Key	Display
② a	a
$\times$	a
b	b
$\%$	$a \cdot b / 100$
$-$	$a \cdot b / 100$
$=$	$a (1 - b / 100)$
④ a	a
$-$	a
b	b
$\%$	$a (1 - b / 100)$
⑥ a	a
$\times$	a
b	b
$+/-$	- b
$\Delta\%$	$a (1 - b / 100)$

MAXIMUM RATINGS

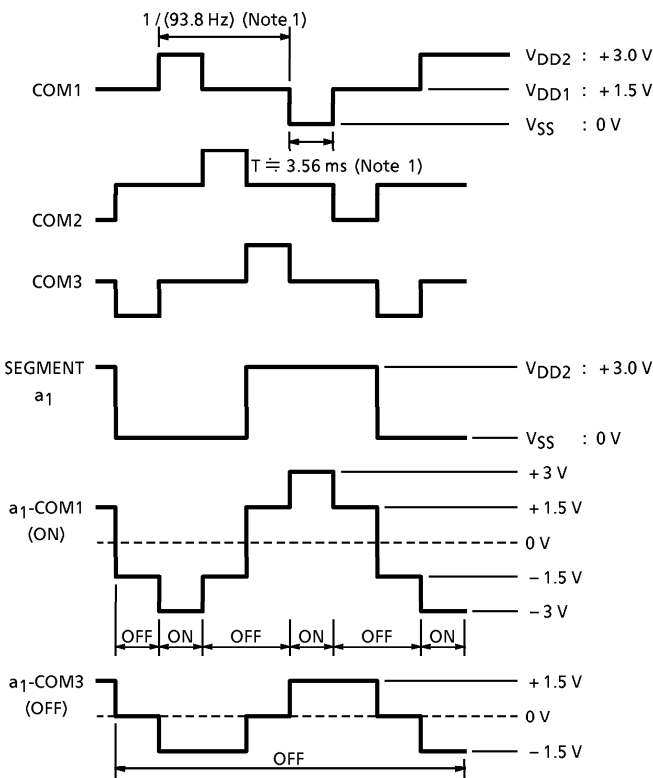
CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD1}	$-0.3 \sim 2.0$	V
Input Voltage	V_{IN}	$-0.3 \sim V_{DD1} + 0.3$	V
Operating Temperature	T_{opr}	$0 \sim 40$	°C
Storage Temperature	T_{stg}	$-55 \sim 125$	°C

ELECTRICAL CHARACTERISTICS ($V_{DD1} = 1.5 \pm 0.2$ V, $V_{DD2} = 3.0 \pm 0.4$ V, $V_{SS} = 0$ V, $T_a = 25^\circ\text{C}$)

CHARACTERISTICS	SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	V_{DD1}	—	—	—	1.2	1.5	2.0	V
"1" Input Voltage	$V_{IH}(1)$	—	K ₂ ~K ₉ RESET	—	$V_{DD1} - 0.4$	—	V_{DD1}	V
"1" Input Voltage	$V_{IH}(2)$	—	K ₁₀ ~K ₁₃	—	$V_{DD2} - 0.4$	—	V_{DD2}	V
"0" Input Voltage	V_{IL}	—	K ₂ ~K ₁₃ RESET	—	0	—	0.4	V
"1" Output Voltage	$V_{OH}(1)$	—	SEGMENT COM1~3	—	$V_{DD2} - 0.2$	—	V_{DD2}	V
"0" Output Voltage	$V_{OL}(1)$	—	SEGMENT COM1~3	—	0	—	0.2	V
"M" Output Voltage	V_{OM}	—	COM1~3	—	$V_{DD1} - 0.2$	—	$V_{DD1} + 0.2$	V
"1" Output Voltage	$V_{OH}(2)$	—	K ₁ ~K ₉	—	$V_{DD1} - 0.2$	—	V_{DD1}	V
"0" Output Voltage	$V_{OL}(2)$	—	K ₁ ~K ₁₃	—	0	—	0.2	V
"1" Output Resistance	R_{OH}	—	SEGMENT COM1~3	$V_{OUT} = V_{DD2} - 0.5$ V	—	—	70	k Ω
"0" Output Resistance	R_{OL}	—	SEGMENT COM1~3	$V_{OUT} = 0.5$ V	—	—	70	k Ω
KEY Pull Up Resistance	$R_{KEYH}(1)$	—	RESET	$V_{OUT} = V_{DD1} - 0.5$ V	—	—	25	k Ω
	$R_{KEYH}(2)$	—	K ₀ ~K ₉	$V_{OUT} = V_{DD1} - 0.5$ V	—	—	14	k Ω
	$R_{KEYH}(3)$	—	K ₁₀ ~K ₁₃	$V_{OUT} = 0$ V	120	—	800	k Ω
KEY Pull Down Resistance	$R_{KEYL}(1)$	—	RESET (1)	$V_{OUT} = V_{DD1}$	100	—	300	k Ω
	$R_{KEYL}(2)$	—	RESET (2)	$V_{OUT} = V_{DD1}$	18	—	300	k Ω
	$R_{KEYL}(3)$	—	K ₀ ~K ₉ (1)	$V_{OUT} = 0.5$ V	—	—	50	k Ω
	$R_{KEYL}(4)$	—	K ₀ ~K ₉ (2)	$V_{OUT} = V_{DD1}$	72	—	170	k Ω
Oscillating (WAIT)	$f_{\phi WAIT}$	—	—	$V_{DD1} = 1.5$ V	5.4	9.0	15.5	kHz
Frequency (OPERATE)	$f_{\phi OP}$	—	—	$V_{DD1} = 1.5$ V	20.0	34	61.3	kHz
Frame Frequency	f_F	—	SEGMENT COM1~3	$V_{DD1} = 1.5$ V	56.3	93.8	161.5	Hz

CHARACTERISTIC		SYMBOL	TEST CIR- CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Supply Current	1 (WAIT)	I _{DDWAIT}	—	—	V _{DD1} = 1.5 V	—	—	3.3	μA
	2 (OPERATE)	I _{DDOP}	—	—	V _{DD1} = 1.2 V	—	—	8.9	μA
	3 (OFF)	I _{DDOFF}	—	—	V _{DD1} = 1.5 V	—	—	2.0	μA
Power Off Timer Times		T	—	—	V _{DD1} = 1.5 V	429	600	1001	s

WAVEFORMS FOR DISPLAY



(Note 1) : at $f\phi = 9\text{ kHz}$

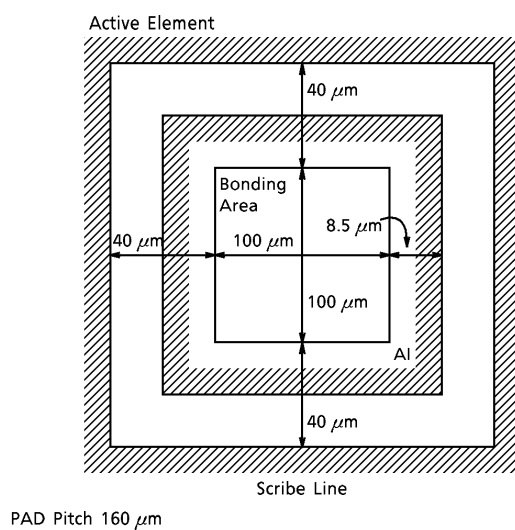
PAD LOCATION TABLE

(μm)

NAME	X POINT	Y POINT	NAME	X POINT	Y POINT
COM3	- 1757	- 1680	B ₁₃	1757	1680
COM2	- 1757	- 1520	A ₁₃	1757	1520
COM1	- 1757	- 1360	C ₁₂	1757	1360
K ₁₃	- 1757	- 1200	B ₁₂	1757	1200
K ₁₂	- 1757	- 1040	A ₁₂	1757	1040
K ₁₁	- 1757	- 880	C ₁₁	1757	880
K ₁₀	- 1757	- 720	B ₁₁	1757	720
K ₉	- 1757	- 560	A ₁₁	1757	560
K ₈	- 1757	- 400	C ₁₀	1757	400
K ₇	- 1757	- 240	B ₁₀	1757	240
K ₆	- 1757	- 80	A ₁₀	1757	80
K ₅	- 1757	80	C ₉	1757	- 80
K ₄	- 1757	240	B ₉	1757	- 240
K ₃	- 1757	400	A ₉	1757	- 400
K ₂	- 1757	560	C ₈	1757	- 560
K ₁	- 1757	720	B ₈	1757	- 720
K ₀	- 1757	880	A ₈	1757	- 880
(TS4)	- 1757	1040	C ₇	1757	- 1040
(TS3)	- 1757	1200	B ₇	1757	- 1200
(TS2)	- 1757	1360	A ₇	1757	- 1360
(TS1)	- 1757	1520	C ₆	1757	- 1520
RESET	- 1757	1680	B ₆	1757	- 1680
V _G	- 1388	1753	A ₆	1278	- 1752
V _{DD1}	- 1151	1753	C ₅	1118	- 1752
V _{DD2}	- 991	1753	B ₅	958	- 1752
V _B	- 831	1753	A ₅	798	- 1752
V _A	- 671	1753	C ₄	638	- 1752
V _{SS}	- 511	1753	B ₄	478	- 1752
S ₄	- 351	1753	A ₄	318	- 1752
S ₃	- 191	1753	C ₃	158	- 1752
S ₂	- 31	1753	B ₃	- 2	- 1752
S ₁	129	1753	A ₃	- 162	- 1752
B ₁₅	289	1753	C ₂	- 322	- 1752
A ₁₅	449	1753	B ₂	- 482	- 1752
C ₁₄	609	1753	C ₂	- 642	- 1752
B ₁₄	769	1753	C ₁	- 802	- 1752
A ₁₄	929	1753	B ₁	- 962	- 1752
C ₁₃	1089	1753	A ₁	- 1122	- 1752

(Note) : () Do not connect.

Chip size : 3.79×3.84 (mm)
 Chip thickness : 440 ± 30 (μm)
 Substrate : V_{SS}



QFP80-P-1420-0.80A

The drawing shows a rectangular component with the following dimensions and tolerances:

- Overall width: 24.8 ± 0.3
- Overall height: 18.8 ± 0.3
- Inner width: 20.0 ± 0.2
- Inner height: 14.0 ± 0.2
- Top-left corner radius: 64
- Top-right corner radius: 41
- Bottom-left corner radius: 80
- Bottom-right corner radius: 24
- Left side feature: 65 (width), 1.0TYP (height)
- Right side feature: 40 (width), 25 (height)
- Bottom-left feature: 1 (width), 0.8TYP (height)
- Bottom-right feature: 0.35 $\pm$ 0.1 (width), 0.16 (M) (height)
- Bottom center feature: 0.8 (width)
- Bottom edge feature: 0.2 $\pm$ 0.1 (width), 2.7 $\pm$ 0.2 (height), 3.05MAX (total height)
- Bottom-left corner feature: 0.15 $^{+0.1}_{-0.05}$ (width), 1.2 $\pm$ 0.2 (height)

2000-03-22 17/17