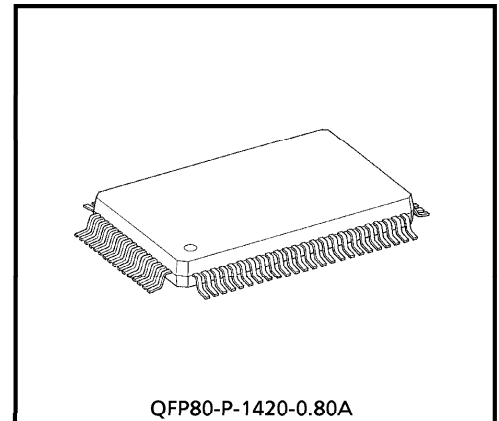


TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

T6M81A, JT6M81A-AS

T6M81A, JT6M81A-AS CMOS SINGLE-CHIP LSI FOR LCD CALCULATOR

The T6M81A, JT6M81A-AS is a CMOS single-chip microcomputer for 16-digit 1-memory calculator. T6M81A, JT6M81A-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 T6M81A, JT6M81A-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).

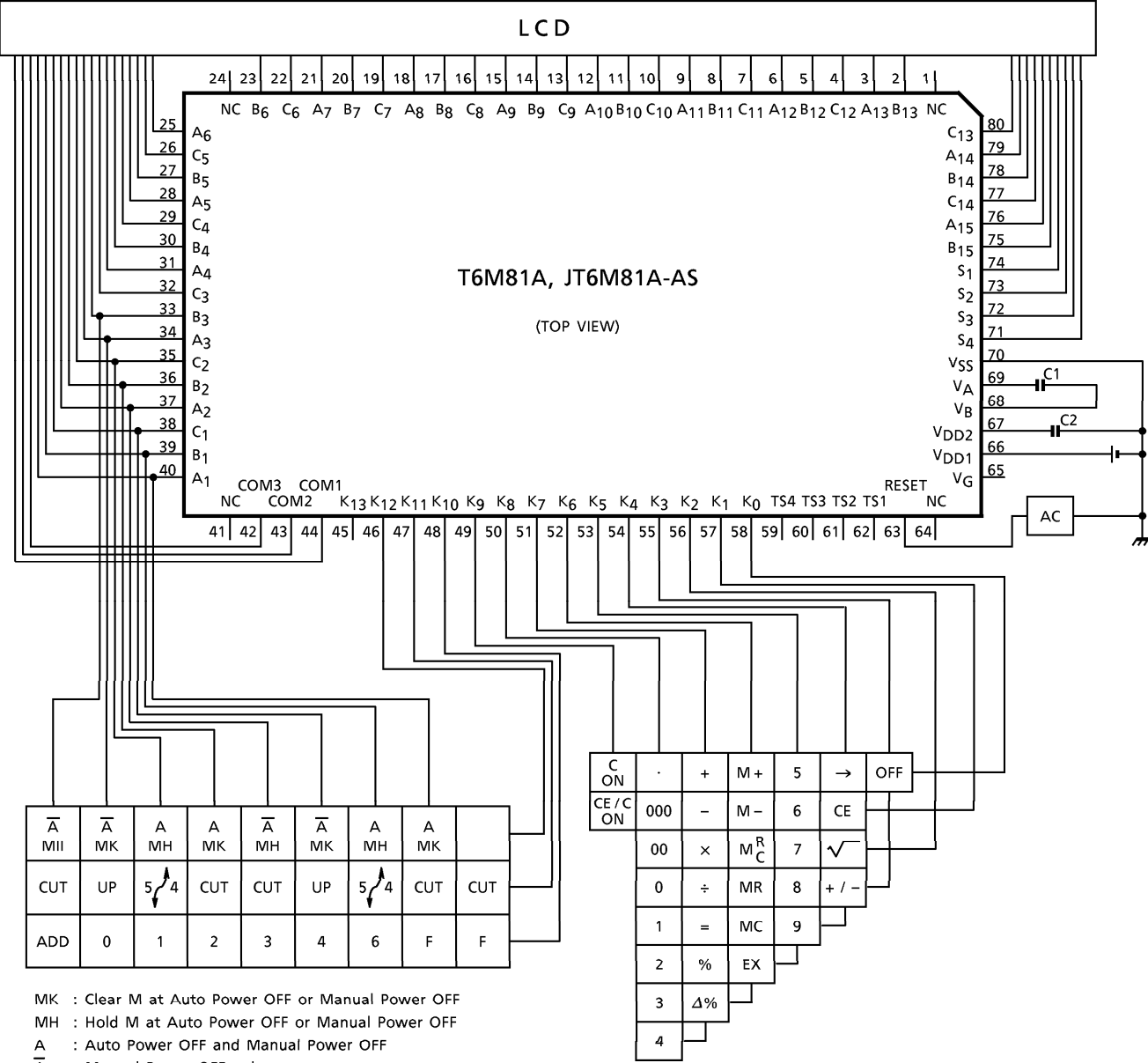
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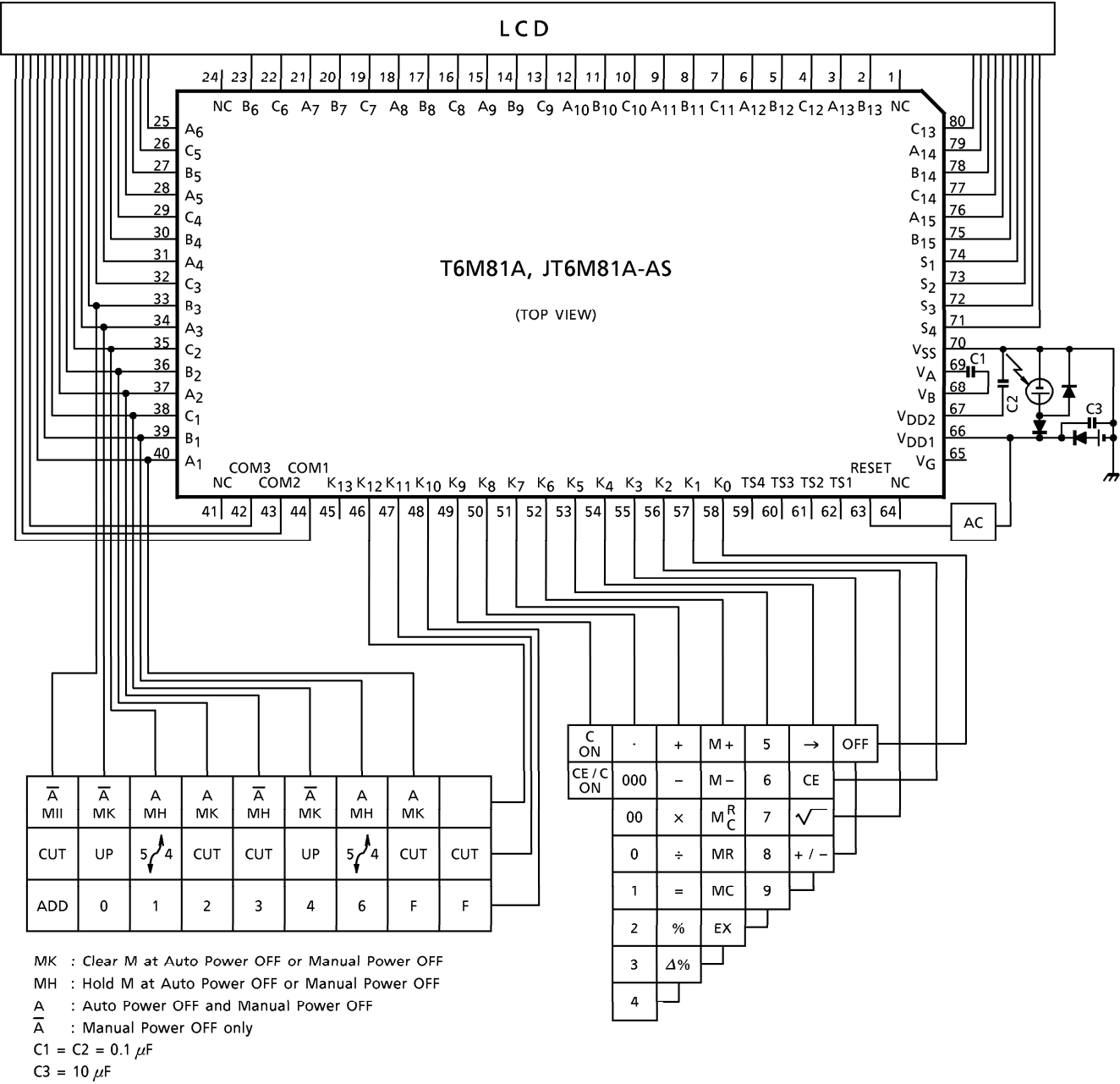
- Rounding switches (rounding up, down and off).
- Leading zero suppression.
- Trailing zero suppression.
- Punctuation on display, commas for thousands.
- Memory contents indicator, turned on with non-zero in the memory.
- Registration overflow, indicating that too many digits are entered (the most 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

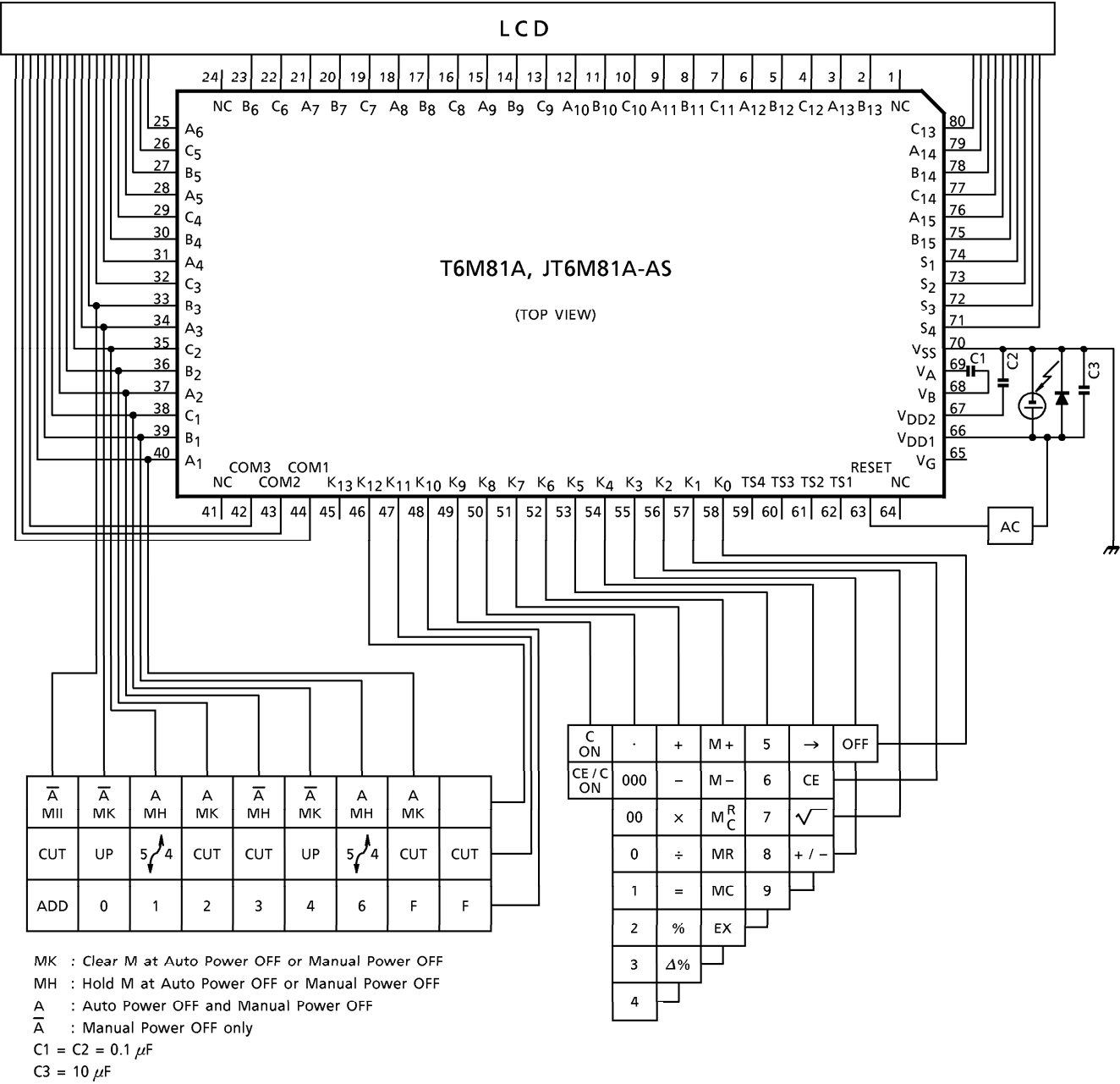
Battery Type



Dual Type

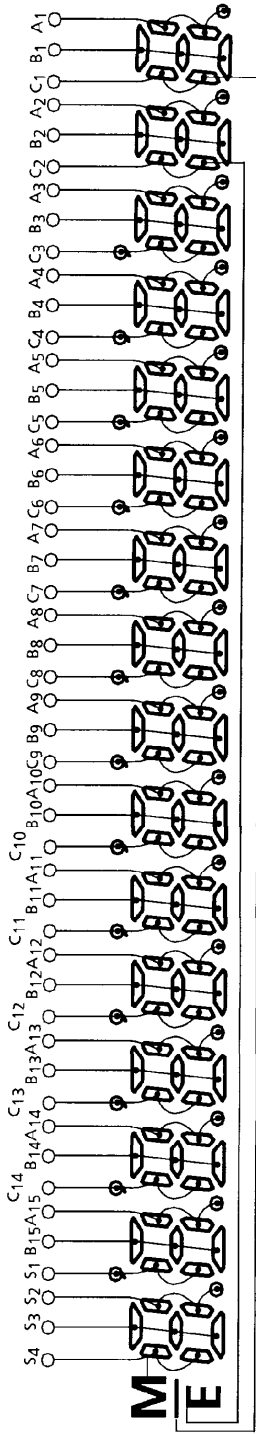


Solar Type

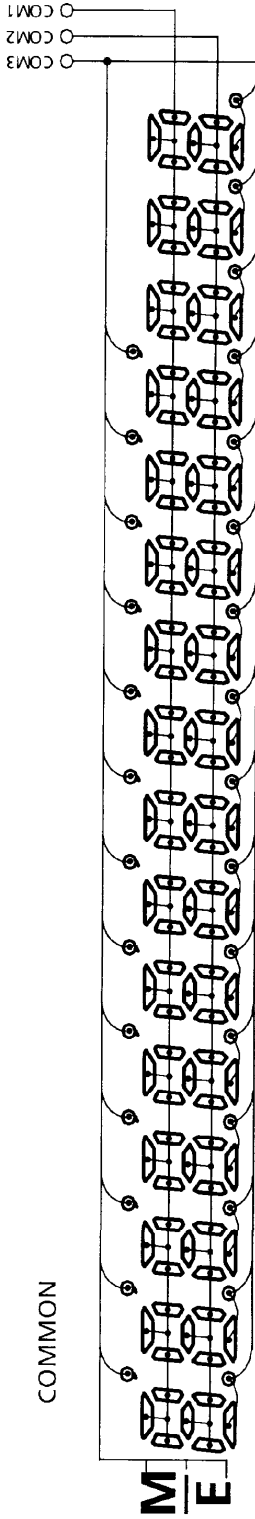


CONNECTION OF LCD

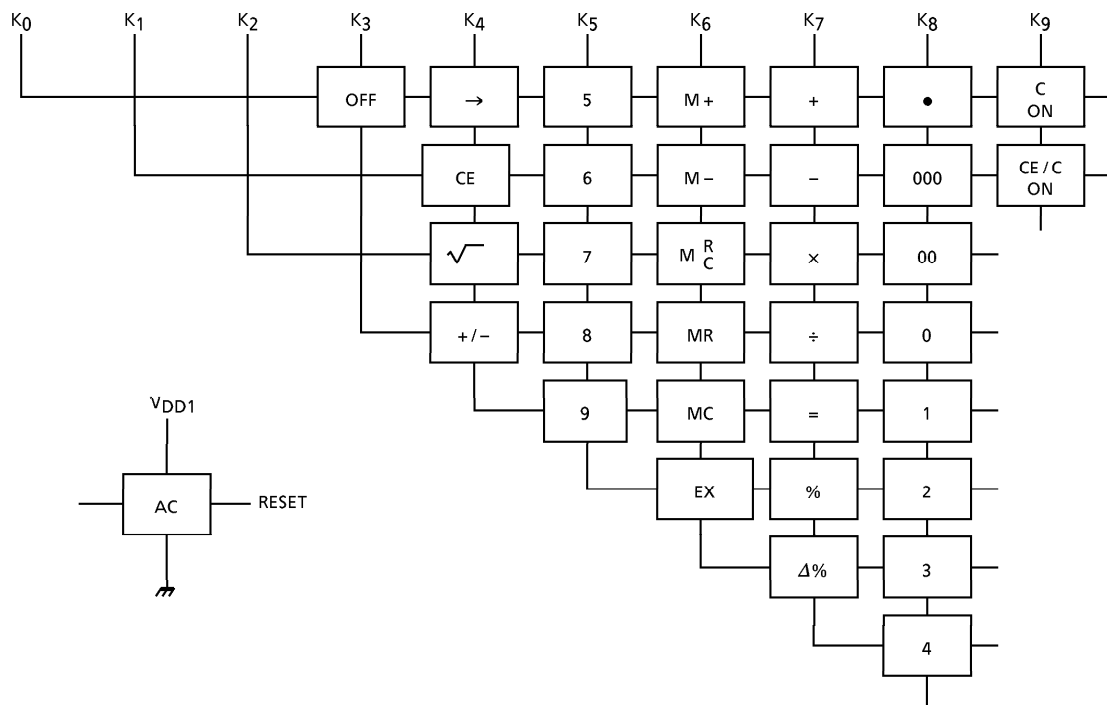
SEGMENT



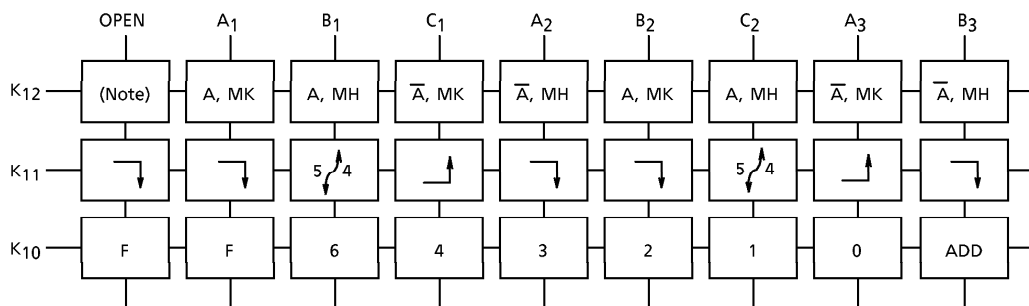
COMMON



KEY CONNECTION



Touch Key



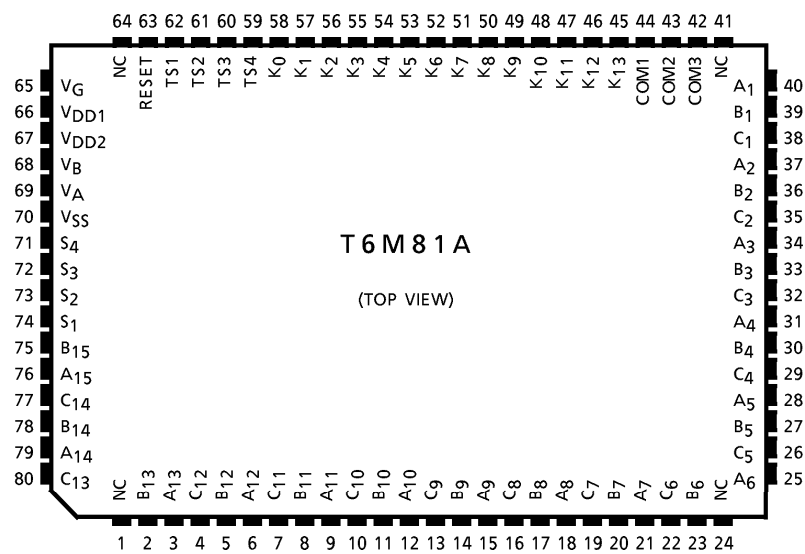
Lock Key

- K₁₂ Selectable with Auto Power OFF mode and Total switch.
 MH (Memory Hold), MK (Memory Kill)
 K₁₁ Rounding switches
 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 $\bar{A}$, MH Mode selected.

PIN ASSIGNMENT



SPECIFICATION OF CALCULATOR

Speed of calculation

Numeral		27.8~40.9 ms
Function	{ 1 $\boxed{+}$ 1 $\boxed{+}$ 2 $\boxed{+}$	42.7 ms 83.9 ms
Addition and subtract	{ 1 2 3 $\boxed{+}$ 1 $\boxed{=}$ 9999999999999999 $\boxed{-}$ 0.0000000000000001 $\boxed{=}$	82.8 ms 106.4 ms
Multiply	{ 1 2 3 $\boxed{\times}$ 2 $\boxed{=}$ 1 $\boxed{\times}$ 9999999999999999 $\boxed{=}$	110.8 ms 309.9 ms
Device	{ 1 2 3 $\boxed{\div}$ 3 $\boxed{=}$ 9999999999999999 $\boxed{\div}$ 1 $\boxed{=}$	165.1 ms 348.4 ms
Memory calculation	{ 2 $\boxed{M+}$ 9999999999999999 $\boxed{\div}$ 1 $\boxed{M+}$	93.8 ms 388.1 ms
Square root	{ 9999999999999999 $\boxed{\sqrt{}}$ 2 $\boxed{\sqrt{}}$	259.7 ms 170.2 ms

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

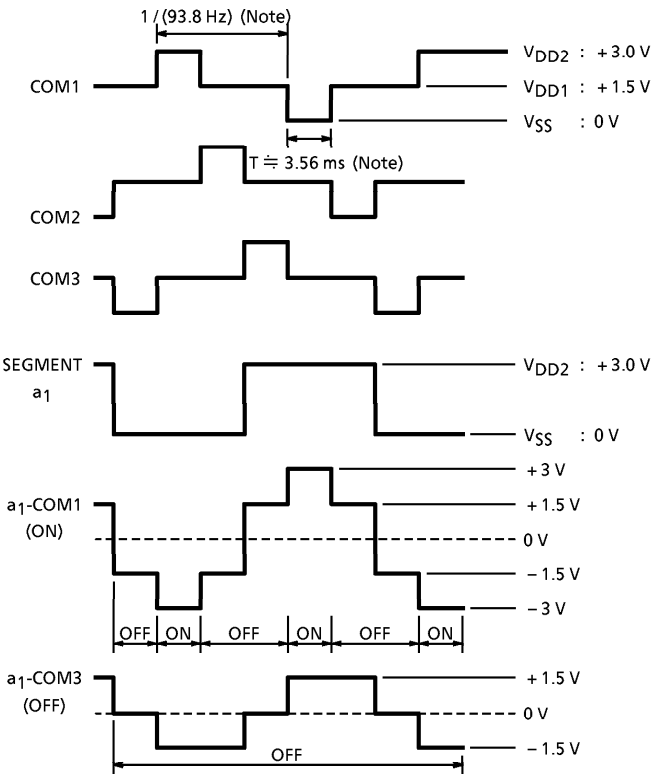
CHARACTERISTICS	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD1}	$-0.3 \sim 2.0$	V
Input Voltage	V_{IN}	$-0.3 \sim V_{DD1} + 0.3$	V
Operating Temperature	T_{opr}	$0 \sim 40$	°C
Storage Temperature	T_{stg}	$-55 \sim 125$	°C

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

CHARACTERISTICS	SYMBOL	TEST CIR- CUIT	PIN NAME	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{DDWAIT}	—	—	$V_{DD1} = 1.5\text{ V}$	—	—	3.3	μA
	I_{DDOP}	—	—	$V_{DD1} = 1.2\text{ V}$	—	—	8.9	μA
	I_{DDOFF}	—	—	$V_{DD1} = 1.5\text{ V}$	—	—	2.0	μA
Power Off Timer Times	T	—	—	$V_{DD1} = 1.5\text{ V}$	429	600	1001	s

WAVEFORMS FOR DISPLAY



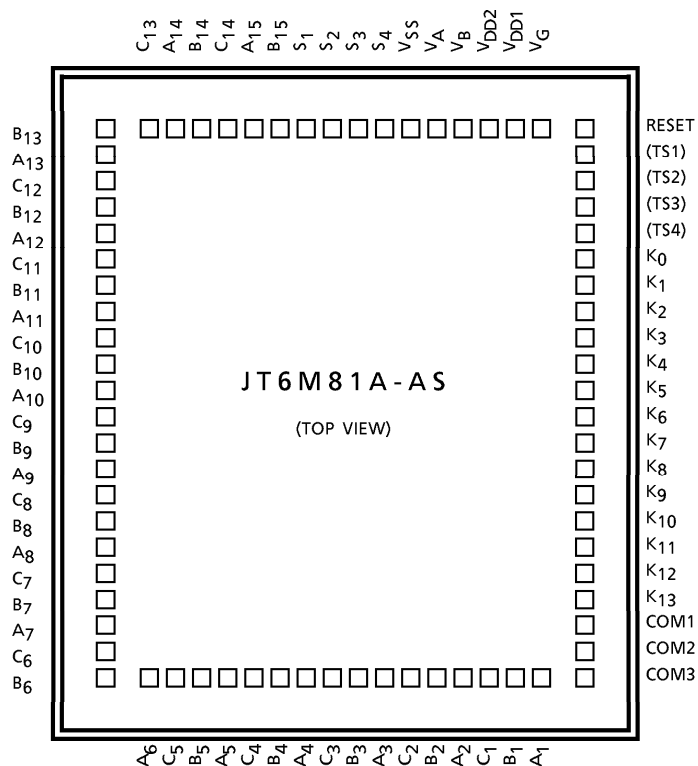
PAD LOCATION TABLE

(μm)

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

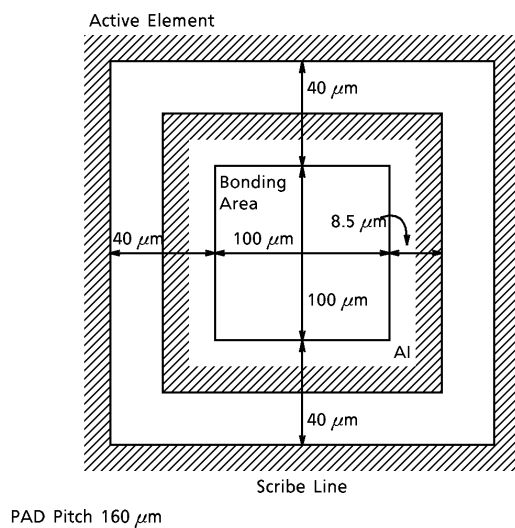
(Note) : () Do not connect.

CHIP LAYOUT



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

PAD LAYOUT



QFP80-P-1420-0.80A

Technical drawing of a 100-pin Quad Flat Pack (QFP) package. The drawing includes a top view, a side view, and a detail view of the lead profile.

Top View Dimensions:

- Overall width: 24.8 ± 0.3 mm
- Overall height: 18.8 ± 0.3 mm
- Pin pitch: 0.8 mm
- Pin 1 location: Indicated by a circle and the number 1.
- Pin counts: 64 pins on the top edge, 41 pins on the right edge, 25 pins on the bottom edge, and 80 pins on the left edge.
- Internal dimensions: 20.0 ± 0.2 mm (width of the central area), 14.0 ± 0.2 mm (height of the central area), and 0.35 ± 0.1 mm (distance from the bottom edge to the center of the package).

Side View Dimensions:

- Maximum height: 3.05 mm
- Body height: 2.7 ± 0.2 mm
- Lead height: 0.2 ± 0.1 mm

Detail View Dimensions:

- Lead thickness: $0.15^{+0.1}_{-0.05}$ mm
- Lead width: 1.2 ± 0.2 mm

2000-03-22 17/17