

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.

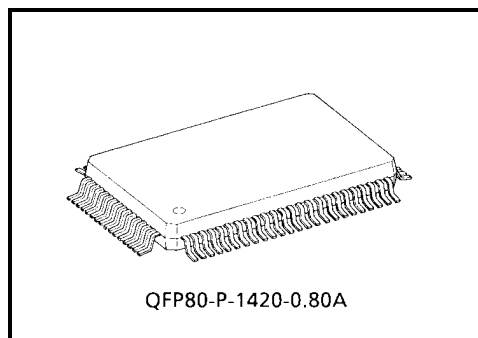
T6M81A, JT6M81A-AS is the complete single-chip CMOS LSI for calculator with single power supply operation.

Wide operating voltage range and low-power consumption make it suitable for 1.5 V solar battery operated.

Besides T6M81A, JT6M81A-AS can be selectable with a pin-programmable to function of Power timer and Memory hold. With the following features.

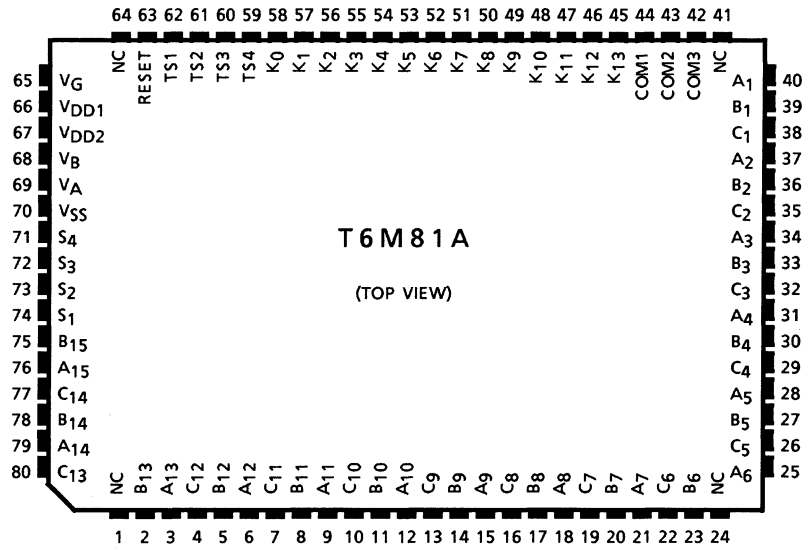
Features

- 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 mark-down 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).
- 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.



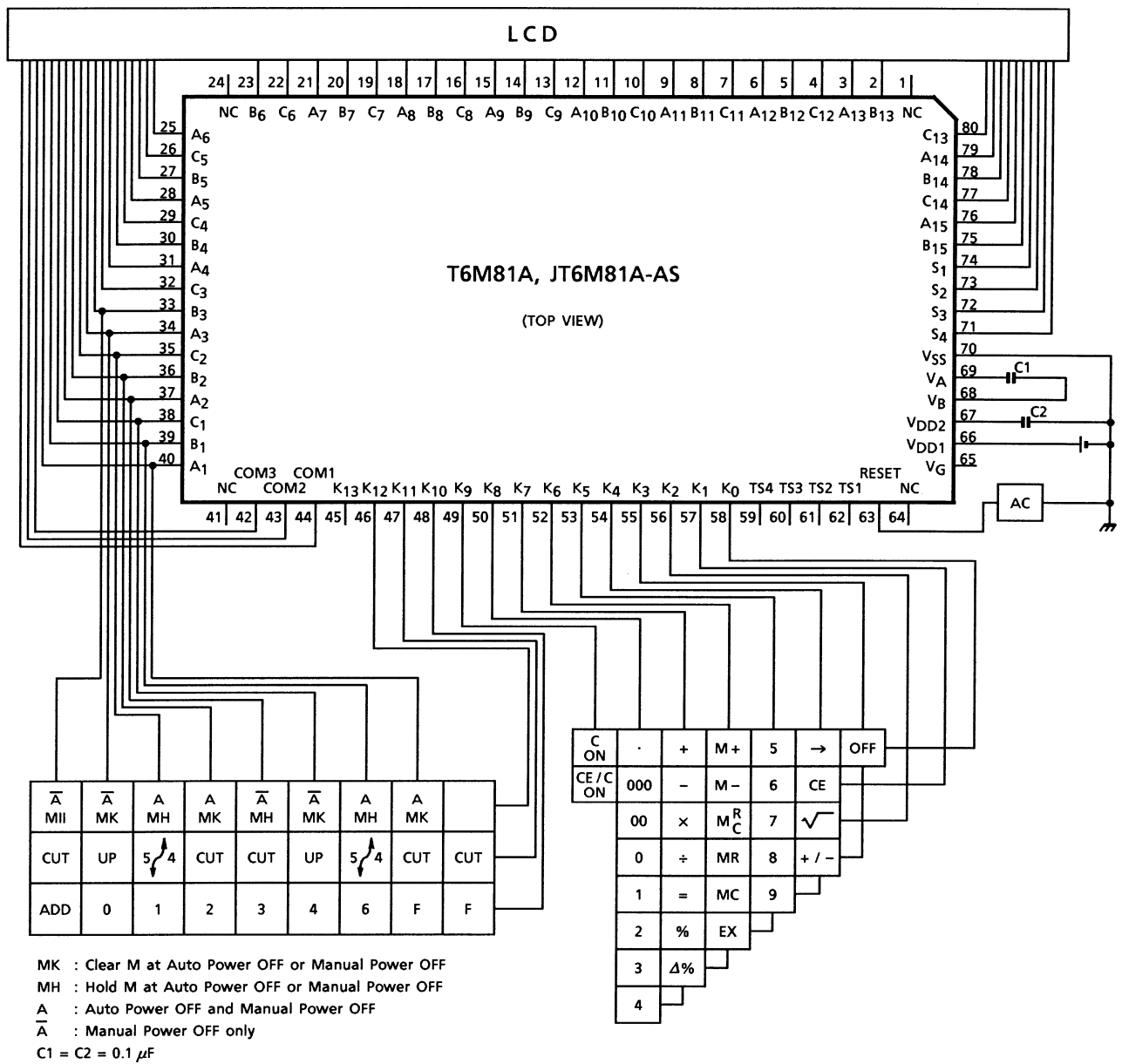
Weight: 1.52 g (typ.)

Pin Assignment (top view)

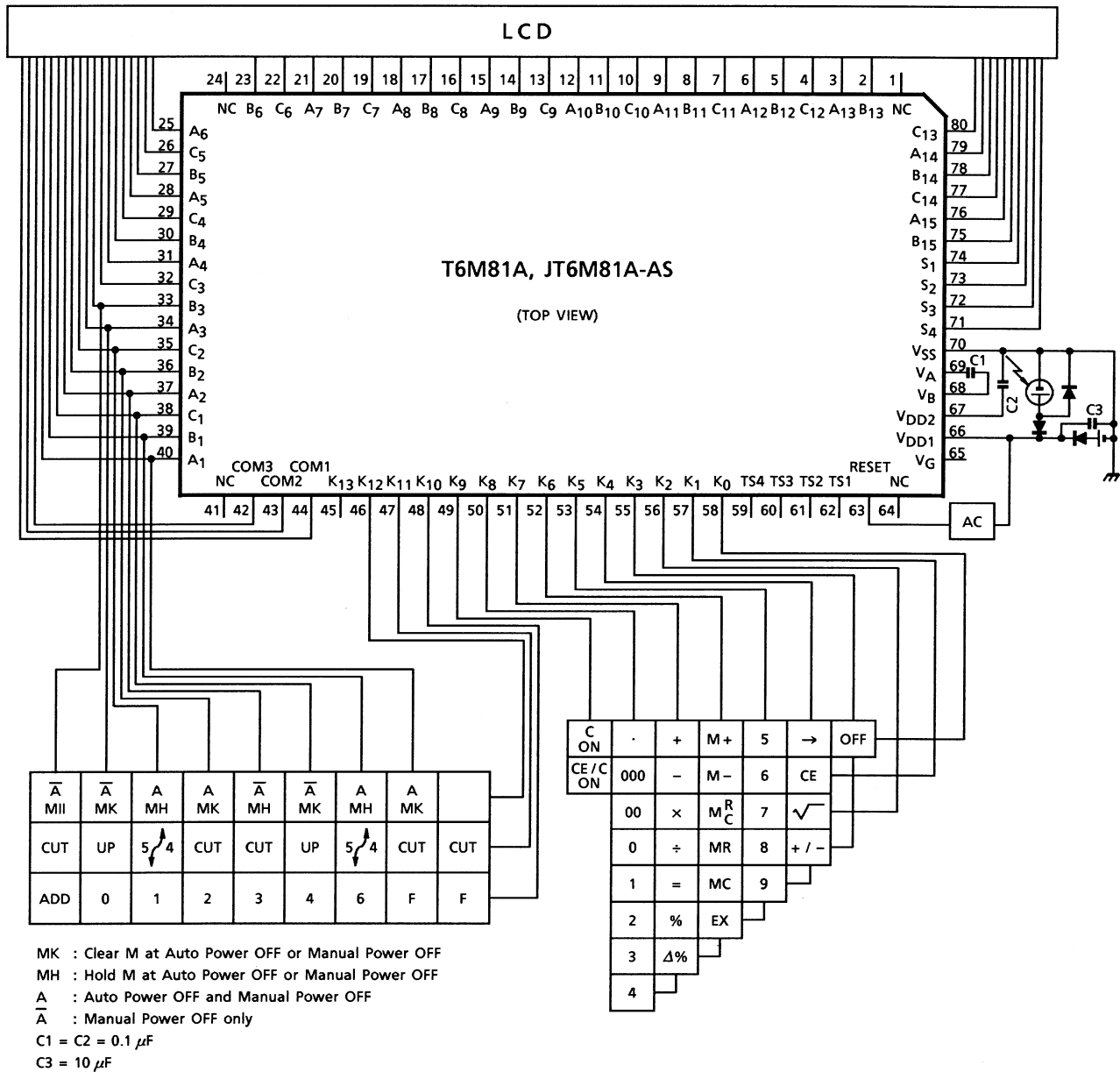


System Block Diagram

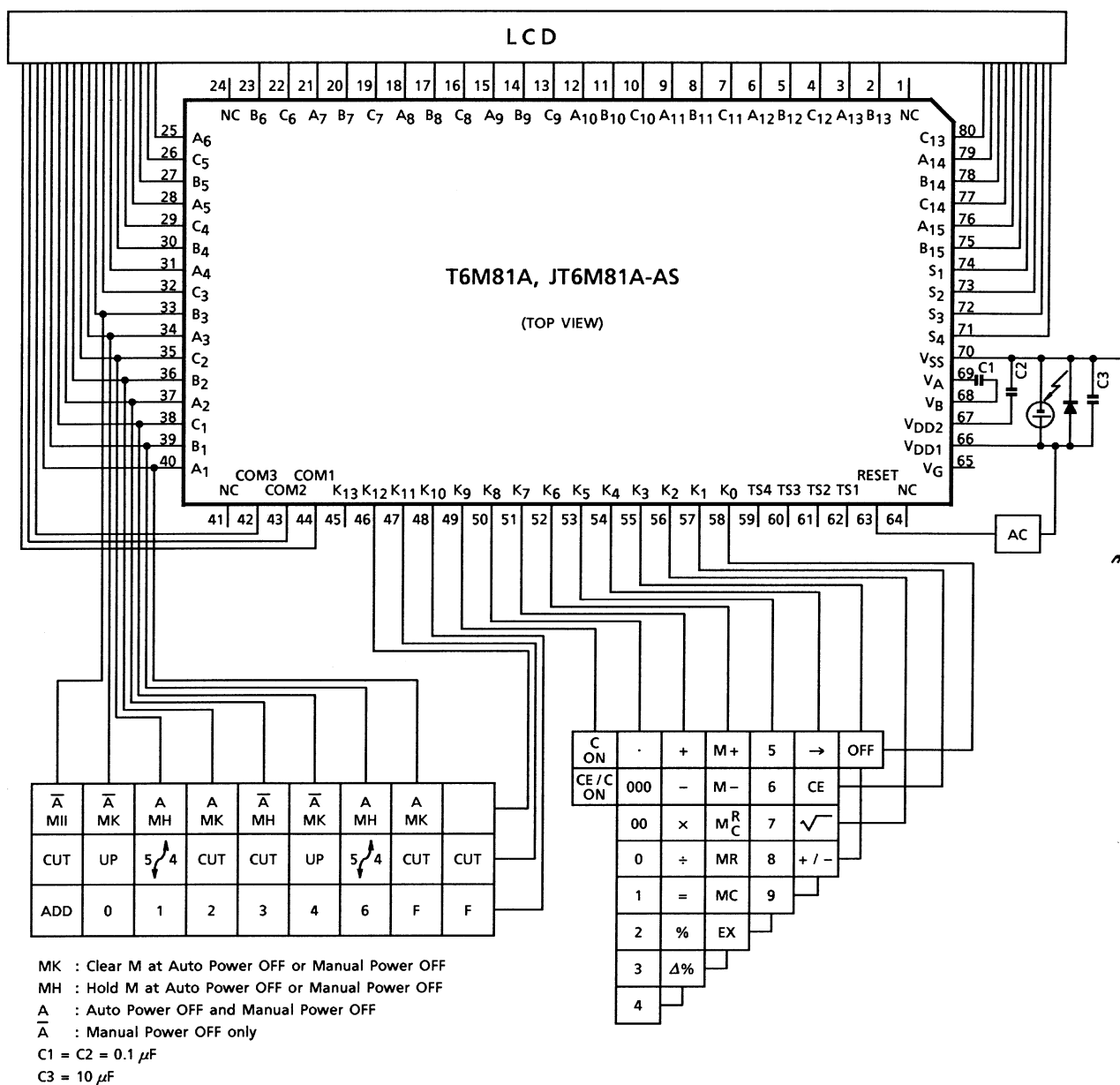
Battery Type



Dual Type

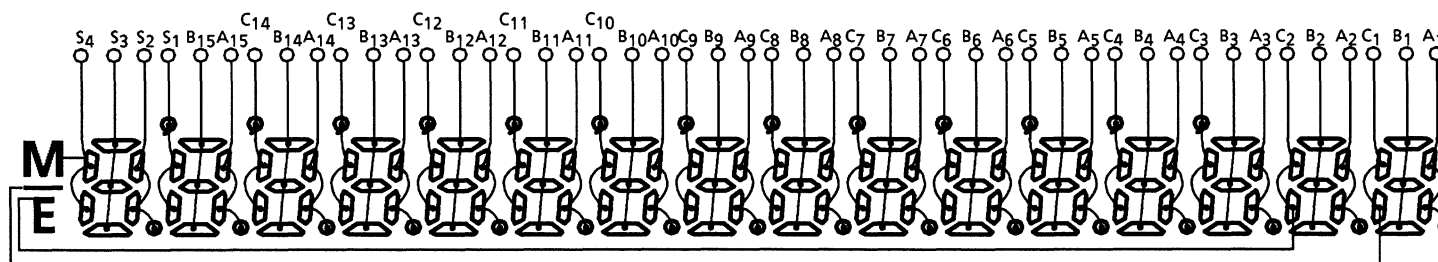


Solar Type

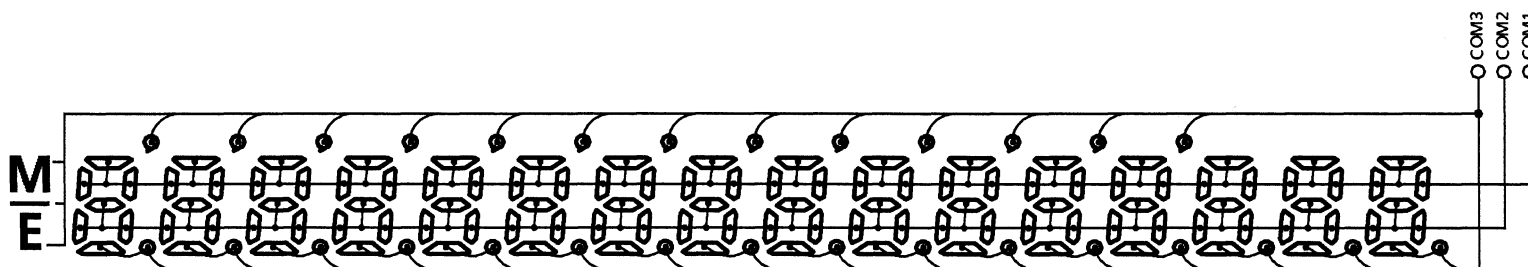


Connection of LCD

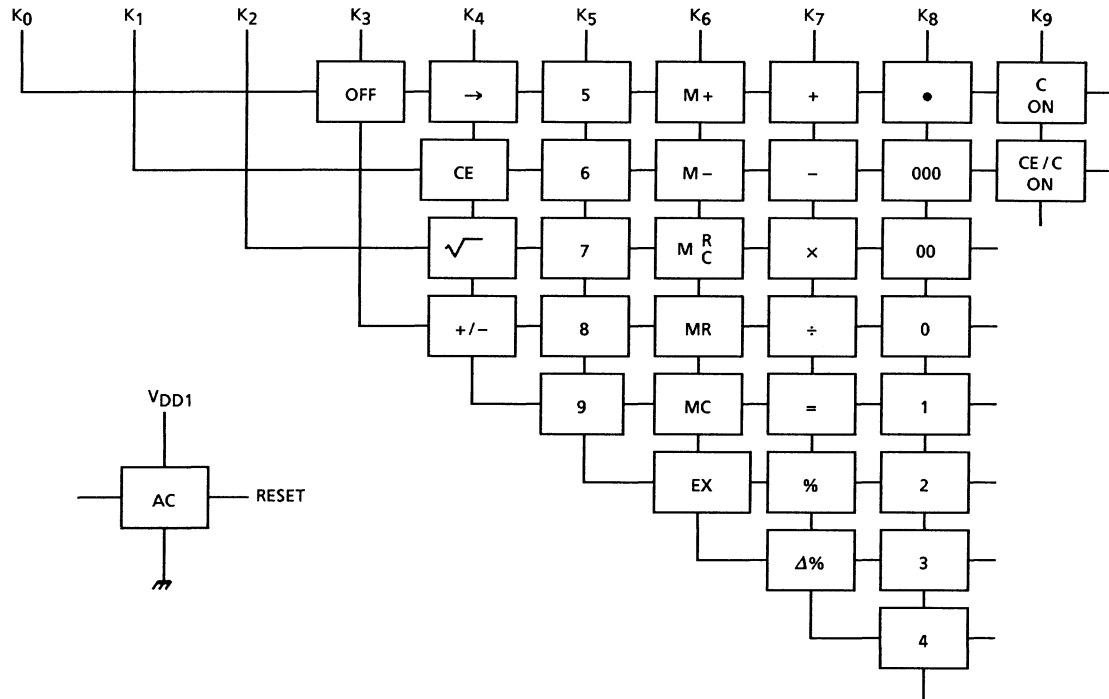
Segment



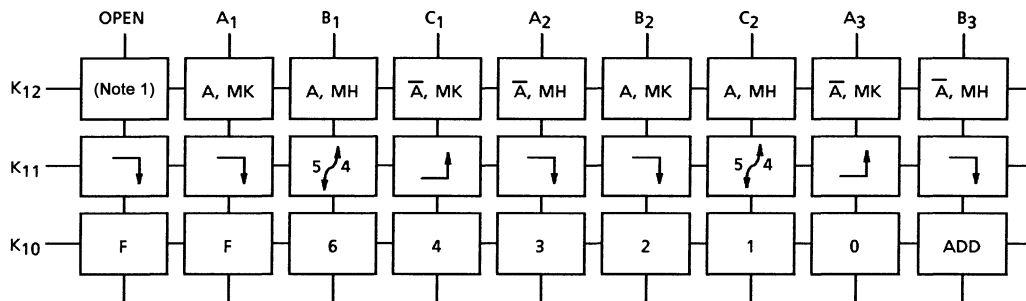
Common



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 1: 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.

Specification of Calculator

Speed of Calculation

Numeral		27.8~40.9 ms
Function	$\left\{ \begin{array}{l} 1 \boxed{+} \dots\dots\dots 42.7 \text{ ms} \\ 1 \boxed{+} 2 \boxed{+} \dots\dots\dots 83.9 \text{ ms} \end{array} \right.$	
Addition and subtract	$\left\{ \begin{array}{l} 1 \ 2 \ 3 \boxed{+} 1 \boxed{=} \dots\dots\dots 82.8 \text{ ms} \\ 9999999999999999 \boxed{-} 0.000000000000001 \boxed{=} \dots\dots\dots 106.4 \text{ ms} \end{array} \right.$	
Multiply	$\left\{ \begin{array}{l} 1 \ 2 \ 3 \boxed{\times} 2 \boxed{=} \dots\dots\dots 110.8 \text{ ms} \\ 1 \boxed{\times} 9999999999999999 \boxed{=} \dots\dots\dots 309.9 \text{ ms} \end{array} \right.$	
Device	$\left\{ \begin{array}{l} 1 \ 2 \ 3 \boxed{\div} 3 \boxed{=} \dots\dots\dots 165.1 \text{ ms} \\ 9999999999999999 \boxed{\div} 1 \boxed{=} \dots\dots\dots 348.4 \text{ ms} \end{array} \right.$	
Memory calculation	$\left\{ \begin{array}{l} 2 \boxed{M+} \dots\dots\dots 93.8 \text{ ms} \\ 9999999999999999 \boxed{\div} 1 \boxed{M+} \dots\dots\dots 388.1 \text{ ms} \end{array} \right.$	
Square root	$\left\{ \begin{array}{l} 9999999999999999 \boxed{\sqrt{}} \dots\dots\dots 259.7 \text{ ms} \\ 2 \boxed{\sqrt{}} \dots\dots\dots 170.2 \text{ ms} \end{array} \right.$	

Operation Example

1. Fixed Point Calculations

(1)	Key	Display	Fixed point Place	(2)	Key	Display	Fixed point Place
	$\boxed{C}$	0.	DP = 3 (5 / 4)		$\boxed{C}$	0.	DP = 0 ($\uparrow$)
	2	2.			1	1.	
	$\boxed{\div}$	2.			$\boxed{\cdot}$	1.	
	3	3.			2	1.2	
	$\boxed{=}$	0.667			3	1.23	
	2	2.			$\boxed{+}$	1.23	
	$\boxed{\cdot}$	2.			1	1.	
	3	2.3			$\boxed{\cdot}$	1.	
	$\boxed{+}$	2.3			1	1.1	
	4	4.			$\boxed{=}$	3.	
	$\boxed{M+}$	6.300			9	9.	
	1	1.			$\boxed{\sqrt{}}$	3.	
	$\boxed{\cdot}$	1.			$\boxed{\times}$	3.	
	2	1.2			1	1.	
	$\boxed{M+}$	1.200			$\boxed{\cdot}$	1.	
	$\boxed{MR}$	7.5	DP = 4		1	1.1	DP = F
					$\boxed{=}$	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			(2) Division		
Key	Display	Constant	Key	Display	Constant
k	k		a	a	
$\boxed{\times}$	k		$\boxed{\div}$	a	
a	a		k	k	
$\boxed{=}$	k·a	k ×	$\boxed{=}$	a / k	÷ k
b	b	k ×	b	b	÷ k
$\boxed{=}$	k·b	k ×	$\boxed{=}$	b / k	÷ k
(3) Addition			(4) Subtraction		
a	a		a	a	
$\boxed{+}$	a		$\boxed{-}$	a	
k	k		k	k	
$\boxed{=}$	a + k	+ k	$\boxed{=}$	a – k	– k
b	b	+ k	b	b	– k
$\boxed{=}$	b + k	+ 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	$k \times$
$\boxed{\%}$	$k \cdot b / 100$	$k \times$

(6) Percentage

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

(7) Add-on

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

(8) Discount

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

4. $\Delta\%$ Calculations

(1)

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

(2)

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) $

(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
	[X]	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
	[X]	a
	b	b
	[Δ%]	$a \cdot (1 + b / 100)$

Discount

	Key	Display
(2)	a	a
	[X]	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
	[X]	a
	b	b
	[+/-]	-b
	[Δ%]	$a (1 - b / 100)$

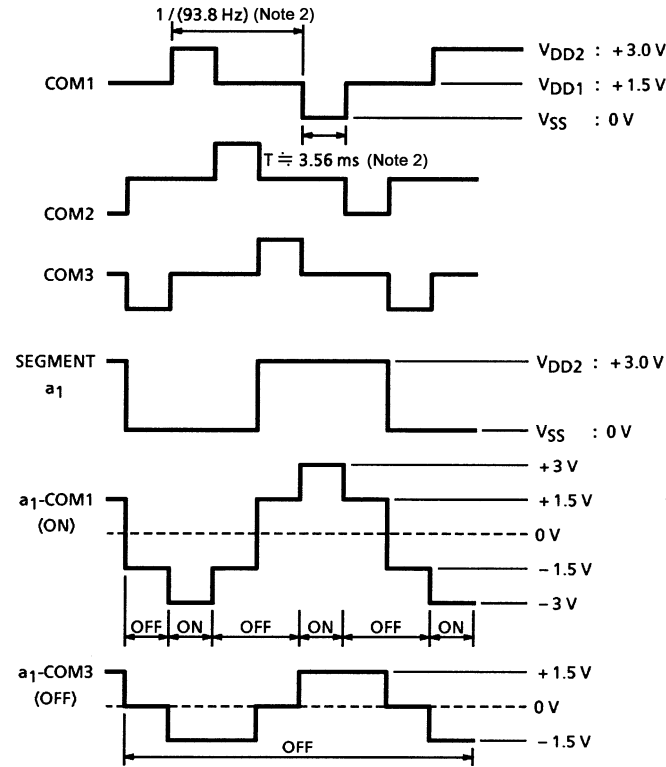
Maximum Ratings

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{DD1}	-0.3~2.0	V
Input voltage	V_{IN}	-0.3~ $V_{DD1} + 0.3$	V
Operating temperature	T_{opr}	0~40	°C
Storage temperature	T_{stg}	-55~125	°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 Circuit	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	
	$R_{KEYH} (3)$	—	K ₁₀ ~K ₁₃	$V_{OUT} = 0$ V	120	—	800	
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	
	$R_{KEYL} (3)$	—	K ₀ ~K ₉ (1)	$V_{OUT} = 0.5$ V	—	—	50	
	$R_{KEYL} (4)$	—	K ₀ ~K ₉ (2)	$V_{OUT} = V_{DD1}$	72	—	170	
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
Supply current	I_{DDWAIT}	—	—	$V_{DD1} = 1.5$ V	—	—	3.3	μA
	I_{DDOP}	—	—	$V_{DD1} = 1.2$ V	—	—	8.9	
	I_{DDOFF}	—	—	$V_{DD1} = 1.5$ V	—	—	2.0	
Power off timer times	T	—	—	$V_{DD1} = 1.5$ V	429	600	1001	s

Waveforms for Display



Pad Location Table

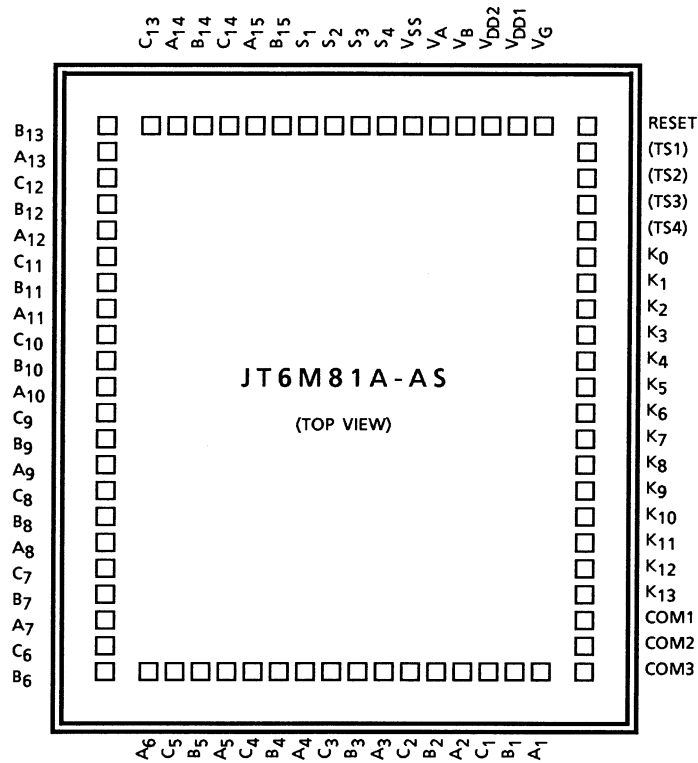
(μm)

Name	X Point	Y Point
B ₆	-1757	-1680
C ₆	-1757	-1520
A ₇	-1757	-1360
B ₇	-1757	-1200
C ₇	-1757	-1040
A ₈	-1757	-880
B ₈	-1757	-720
C ₈	-1757	-560
A ₉	-1757	-400
B ₉	-1757	-240
C ₉	-1757	-80
A ₁₀	-1757	80
B ₁₀	-1757	240
C ₁₀	-1757	400
A ₁₁	-1757	560
B ₁₁	-1757	720
C ₁₁	-1757	880
A ₁₂	-1757	1040
B ₁₂	-1757	1200
C ₁₂	-1757	1360
A ₁₃	-1757	1520
B ₁₃	-1757	1680
C ₁₃	-1089	1753
A ₁₄	-929	1753
B ₁₄	-769	1753
C ₁₄	-609	1753
A ₁₅	-449	1753
B ₁₅	-289	1753
S ₁	-129	1753
S ₂	31	1753
S ₃	191	1753
S ₄	351	1753
V _{SS}	511	1753
V _A	671	1753
V _B	831	1753
V _{DD2}	991	1753
V _{DD1}	1151	1753
V _G	1388	1753

Name	X Point	Y Point
RESET	1757	1680
(TS1)	1757	1520
(TS2)	1757	1360
(TS3)	1757	1200
(TS4)	1757	1040
K ₀	1757	880
K ₁	1757	720
K ₂	1757	560
K ₃	1757	400
K ₄	1757	240
K ₅	1757	80
K ₆	1757	-80
K ₇	1757	-240
K ₈	1757	-400
K ₉	1757	-560
K ₁₀	1757	-720
K ₁₁	1757	-880
K ₁₂	1757	-1040
K ₁₃	1757	-1200
COM1	1757	-1360
COM2	1757	-1520
COM3	1757	-1680
A ₁	1122	-1752
B ₁	962	-1752
C ₁	802	-1752
A ₂	642	-1752
B ₂	482	-1752
C ₂	322	-1752
A ₃	162	-1752
B ₃	2	-1752
C ₃	-158	-1752
A ₄	-318	-1752
B ₄	-478	-1752
C ₄	-638	-1752
A ₅	-798	-1752
B ₅	-958	-1752
C ₅	-1118	-1752
A ₆	-1278	-1752

Note 2: () Do not connect.

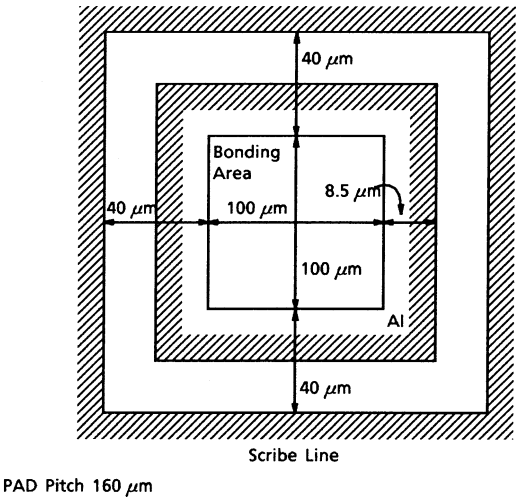
Chip Layout



Chip size : 3.79 × 3.84 (mm)
Chip thickness : 440 ± 30 (μm)
Substrate : VSS

Pad Layout

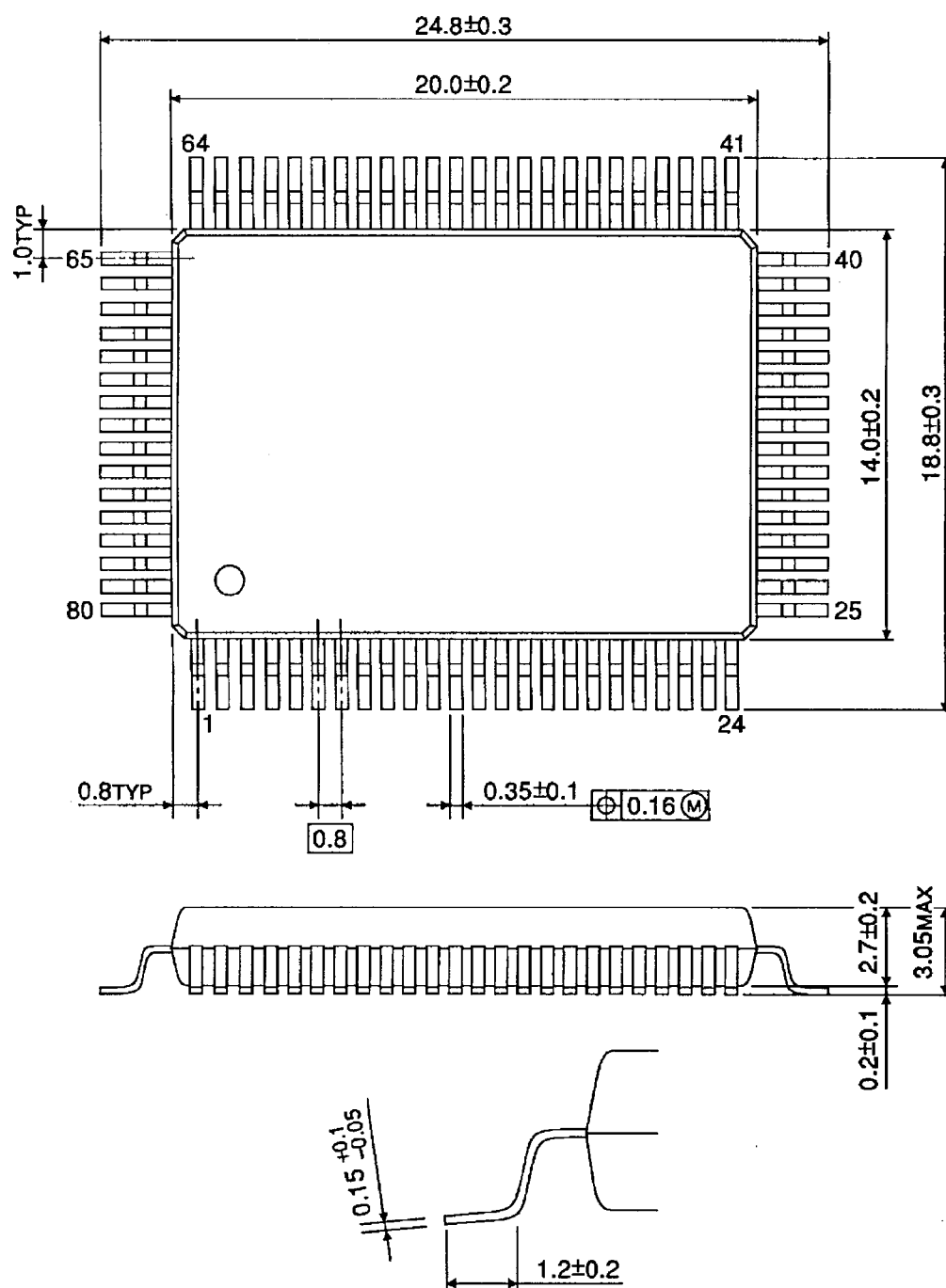
Active Element



Package Dimensions

QFP80-P-1420-0.80A

Unit : mm



Weight: 1.52 g (typ.)

RESTRICTIONS ON PRODUCT USE

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