

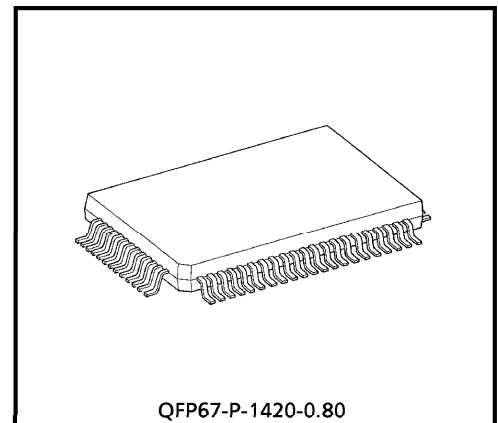
T6A11A, JT6A11AX-AS

T6A11A, JT6A11AX-AS CMOS SINGLE-CHIP LSI FOR LCD CALCULATOR

The T6A11A, JT6A11AX-AS is a single-chip microcomputer for 12-digits 2-memory or 10-digits 2-memory calculator. T6A11A, JT6A11AX-AS can drive the liquid crystal display (LCD) with single power supply.

Single power supply operation, wide operating voltage range and low power consumption make it suitable for 1.5V solar battery operated calculator.

Besides T6A11A, JT6A11AX-AS can be selectable with a pin-programmable to function of Power timer and Memory hold.



QFP67-P-1420-0.80

Weight : 1.20 g (Typ.)

FEATURES

Operational Features :

- Display : 12 digits or 10 digits (selectable with a pin-programmable) of data, 2-digits of sign, error symbol, memory load symbol.
- Algebraic mode.
- Standard 4 functions (+, -, ×, ÷).
- Memory and grand total (GT) memory calculation.
- Accumulating GT memory register with count up (down) item counter.
- 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).

980910EBA2

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- Rounding switches (rounding up, down and off) .
- Leading zero suppression.
- Trailing zero suppression.
- Punctuation on display, commas for thousands.
- Memory and GT memory contents indicator, turned on with non-zero in the memory and GT 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.
- TAX calculation.

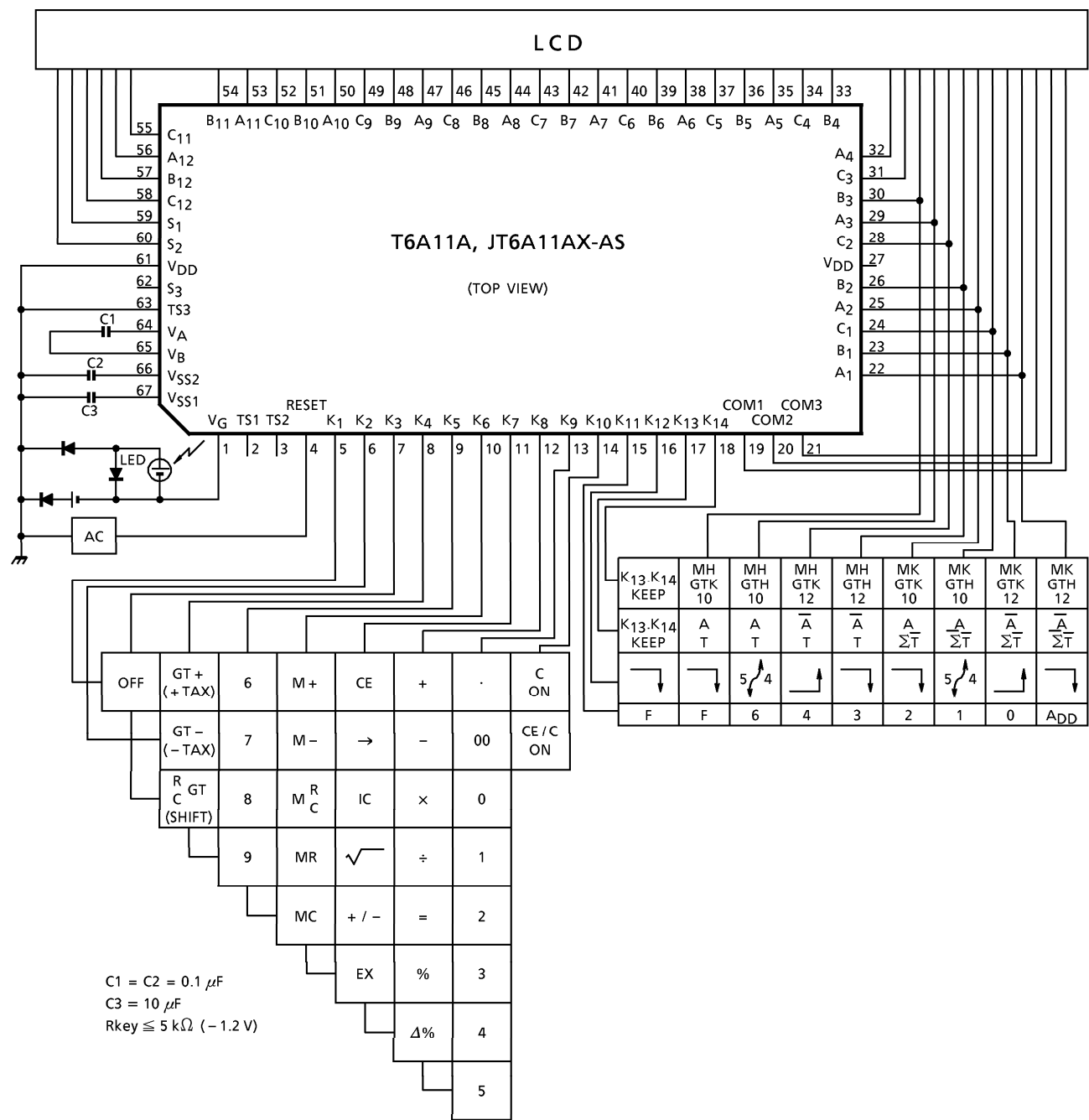
Electrical Features

- Complementary output buffer for direct driving of liquid crystal display (F.E.M LCD) .
- Oscillator/clock generator internal to chip.
- Keyboard encoding internal to chip.
- Keyboard denouncing internal to chip.
- Automatic power on clear.
- Wide supply voltage range (- 1.2 ~ - 2.0 V) .
- Very low power consumption (3.3 μ W typ.) .
- Quad in line flat package.

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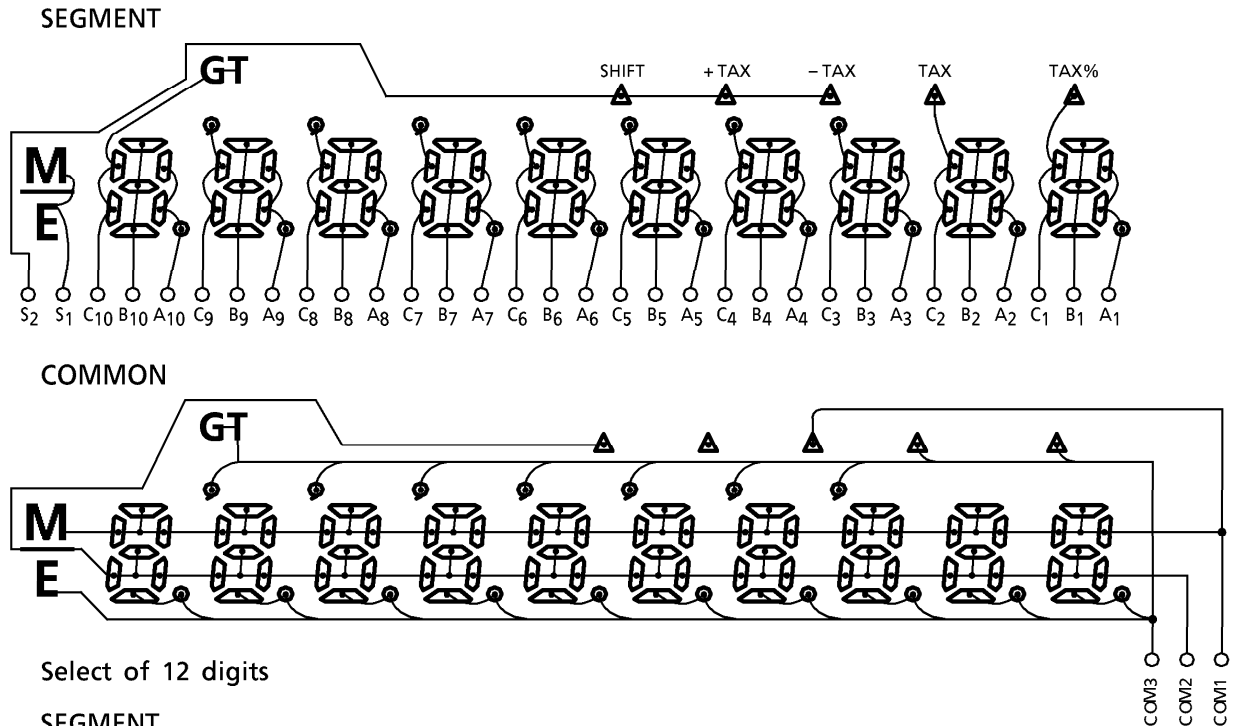
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SYSTEM BLOCK DIAGRAM

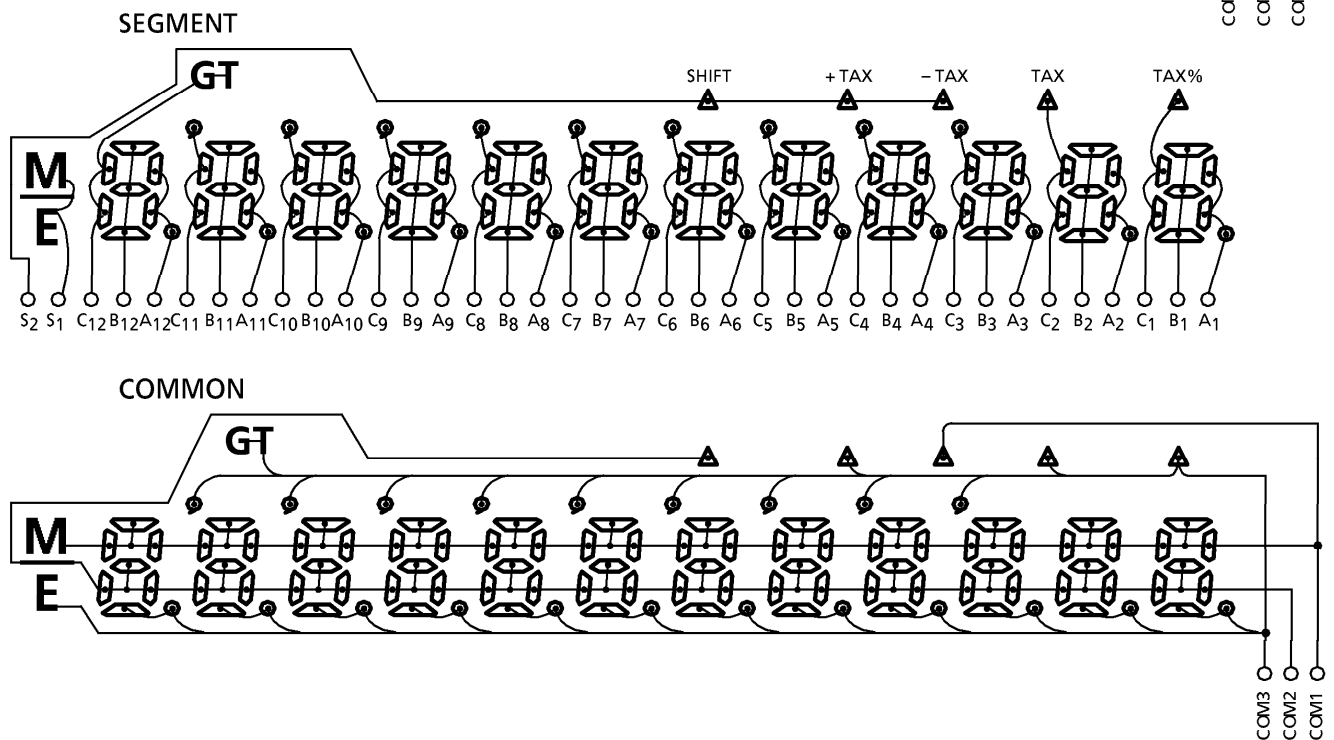


CONNECTION OF LCD

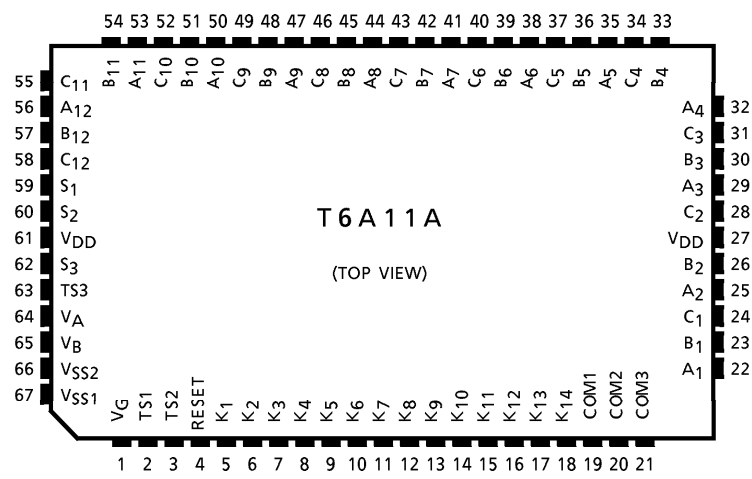
(1) Select of 10 digits



(2) Select of 12 digits

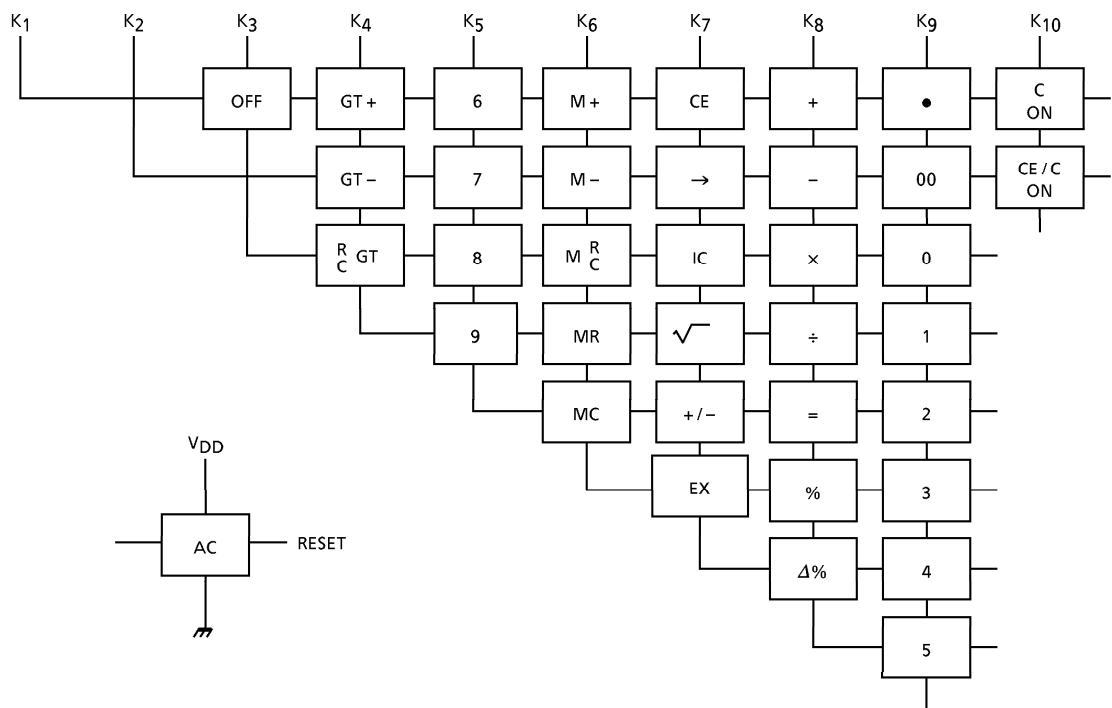


PIN ASSIGNMENT

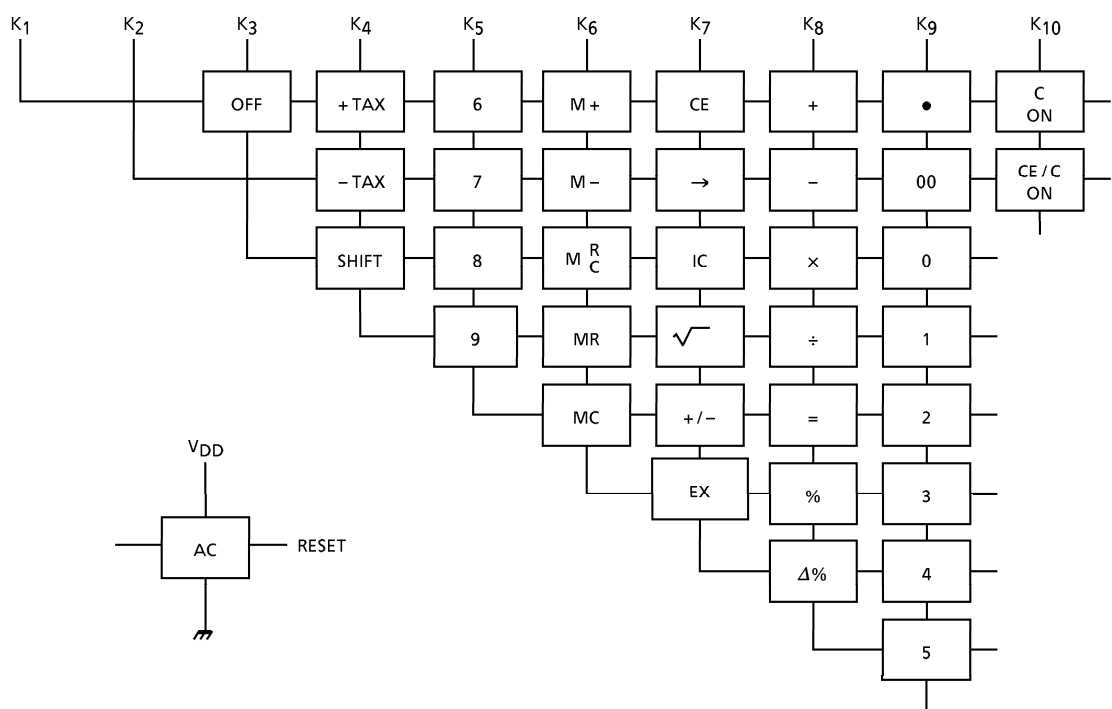


KEY CONNECTION

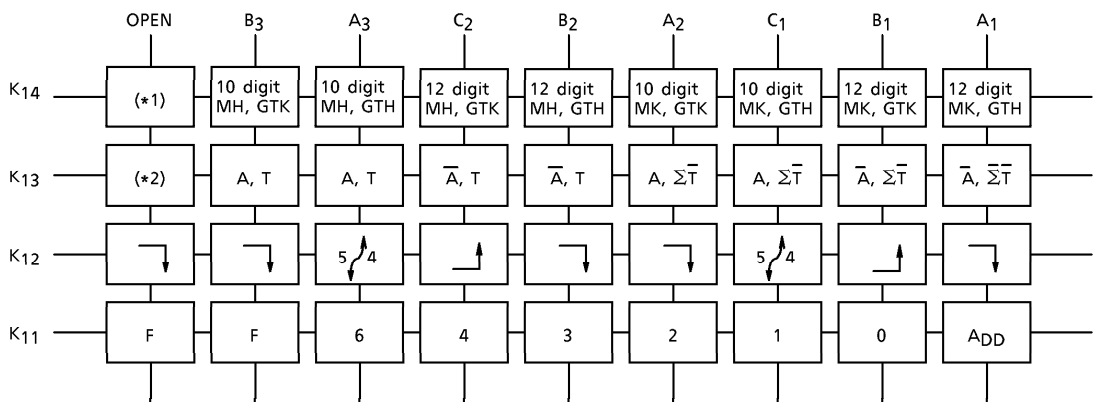
- Touch Key (Ground total memory type)



- Touch Key (TAX calculation type)



● Lock Key



- K14 ... Selectable with calculated digits and memory hold status.
10 digit / 12 digit : Digits of calculation
MH : Memory hold at auto power off or off function.
MK : Memory kill at auto power off or off function.
GTH : GT memory hold at auto power off or off function.
GTK : GT memory kill at auto power off or off function.
- K13 ... Selectable with auto power off mode and TAX calculation mode and total (Σ mode) switch.
A : Auto power off enable.
 $\bar{A}$: Auto power off disable.
(*3) T : TAX calculation mode.
 $\bar{T}$: GT memory mode.
 Σ : Σ mode enable.
 $\bar{\Sigma}$: Σ mode disable.
- K12 ... Rounding switches.
- K11 ... Selectable with fixed point or floating mode.
(*1), (*2) : If K13 or K14 get opened, the status before these keys open is hold. In the case of power on with K13 or K14 open, the status 10 digit and $\bar{\Sigma}$, $\bar{A}$ mode is selected automatically.
(*3) : If exchange the mode of TAX calculation and GT memory, please reset the system for [AC] key.

SPECIFICATION OF CALCULATOR

Speed of Calculator (standard oscillating frequency $f\phi = 48k\text{ Hz}$)

● Numeral		11.8~17.7 ms
● Function	$\left\{ \begin{array}{l} 1 \boxed{+} \dots\dots\dots 25.6 \text{ ms} \\ 1 \boxed{+} 2 \boxed{+} \dots\dots\dots 95.2 \text{ ms} \end{array} \right.$	
● Addition and Subtract	$\left\{ \begin{array}{l} 1 \ 2 \ 3 \boxed{+} 1 \boxed{=} \dots\dots\dots 89.1 \text{ ms} \\ 999999999 \boxed{-} 0.00000001 \boxed{=} \dots\dots 111.8 \text{ ms} \end{array} \right.$	
● Multiply	$\left\{ \begin{array}{l} 1 \ 2 \ 3 \boxed{\times} 2 \boxed{=} \dots\dots\dots 109.6 \text{ ms} \\ 1 \boxed{\times} 999999999 \boxed{=} \dots\dots\dots 207.7 \text{ ms} \end{array} \right.$	
● Device	$\left\{ \begin{array}{l} 1 \ 2 \ 3 \boxed{\div} 3 \boxed{=} \dots\dots\dots 147.9 \text{ ms} \\ 999999999 \boxed{\div} 1 \boxed{=} \dots\dots\dots 249.0 \text{ ms} \end{array} \right.$	
● Memory calculation	$\left\{ \begin{array}{l} 2 \boxed{M+} \dots\dots\dots 143.3 \text{ ms} \\ 999999999 \boxed{\div} 1 \boxed{M+} \dots\dots\dots 296.2 \text{ ms} \end{array} \right.$	
● Square root	$\left\{ \begin{array}{l} 999999999 \boxed{\sqrt{}} \dots\dots\dots 167.7 \text{ ms} \\ 2 \boxed{\sqrt{}} \dots\dots\dots 125.0 \text{ ms} \end{array} \right.$	

Key for Calculator

0 0	,	0	~	9	: Number
.					
+/-					: Changer Sign
+	-	×	÷		: Function
=	√	%	Δ%		
M+	M-	GT+	GT-		: Memory
MC	MR	M^R_C	R^C_{GT}		
EX					: Exchange
→					: Shift
IC					: Item Counter
					Grand total memory type ... MAX. count 999.
					TAX calculation type ... MAX. count 99.
CE	CE/C (ON)	C (ON)			: Clear
	OFF				: OFF
	AC				: SYSTEM RESET

Operation Example

1. Fixed Point calculation

① Key	Display	Fixed Point Place	② Key	Display	Fixed Point Place
$\boxed{C}$	0.	DP = 3 (5 / 4)	$\boxed{C}$	0.	DP = 0 ($\boxed{\text{↑}}$)
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.	
			1	1.1	DP = F
$\boxed{MR}$	7.5		$\boxed{=}$	3.3	

2. Adding Point mode calculation

Key	Display	Key	Display	Key	Display
C	0.	M +	0.02M	=	33.27M –
1	1.	3	3.M	2	2.M
23	123.	.	3.M	+	0.02M
+	1.23	123	3.123M	9	9.M
3	3.	M +	3.12M	.	9.M
=	1.26	MR	3.14M	√	3.M
3	3.	C	0.M	=	3.02M
2	32.	1	1.M		
x	32.	23	123.M		
3	3.	–	1.23M		
.	3.	3	3.M		
000	3.000	4	34.M		
=	96.00	.	34.M		
2	2.	5	34.5M		

3. Constant Calculation

① Multiplication

Key	Display	Constant
k	k	
$\times$	k	
a	a	
$=$	$k \cdot a$	$k \times$
b	b	$k \times$
$=$	$k \cdot b$	$k \times$

③ Addition

a	a	
$+$	a	
k	k	
$=$	$a + k$	$+ k$
b	b	$+ k$
$=$	$b + k$	$+ k$

⑤ Percentage

k	k	
$\times$	k	
a	a	
$\%$	$k \cdot a / 100$	$k \times$
b	b	$k \times$
$\%$	$k \cdot b / 100$	$k \times$

⑦ Add-on

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

② Division

Key	Display	Constant
a	a	
$\div$	a	
k	k	
$=$	a / k	$\div k$
b	b	$\div k$
$=$	b / k	$\div k$

④ Subtraction

a	a	
$-$	a	
k	k	
$=$	$a - k$	$- k$
b	b	$- k$
$=$	$b - k$	$- k$

⑥ Percentage

a	a	
$\div$	a	
k	k	
$\%$	$100 \cdot a / k$	$+ k$
b	b	$\div k$
$\%$	$100 \cdot b / k$	$\div k$

⑧ Discount

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

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) - a $

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
$\boxed{\times}$	a
b	b
$\boxed{\%}$	$a \cdot b / 100$
$\boxed{+}$	$a \cdot b / 100$
$\boxed{=}$	$a (1 + b / 100)$
③ a	a
$\boxed{+}$	a
b	b
$\boxed{\%}$	$a (1 + b / 100)$
⑤ a	a
$\boxed{\times}$	a
b	b
$\boxed{\Delta\%}$	$a (1 + b / 100)$

Discount

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

7. Average Operation use of the Item Counter

Key	Display	Item Counter	Key	Display	Item Counter
A	A	0	$\boxed{-}$	A + B + C + D	2
$\boxed{+}$	A	1	D	D	2
B	B	1	$\boxed{+}$	A + B + C	3
$\boxed{+}$	A + B	2	E	E	3
C	C	2	$\boxed{=}$	A + B + C + E	4
$\boxed{+}$	A + B + C	3	$\boxed{\div}$	A + B + C + E	4
D	D	3	$\boxed{IC}$	4	4
$\boxed{+}$	A + B + C + D	4	$\boxed{=}$	(A + B + C + E) / 4	5

8. TAX Calculation

	Key Op.	Display
(1)	A	A
	$\boxed{SHIFT}$	A $\boxed{SHIFT}$
	$\boxed{+ TAX}$	A $\boxed{TAX\%}$
(2)	$\boxed{SHIFT}$	0. $\boxed{SHIFT}$
	$\boxed{- TAX}$	A $\boxed{TAX\%}$
(3)	B	B
	$\boxed{+ TAX}$	B (1 + A / 100) $\boxed{+ TAX}$
	$\boxed{+ TAX}$	B · A / 100 $\boxed{TAX}$
	$\boxed{+ TAX}$	B (1 + A / 100) $\boxed{+ TAX}$
	$\boxed{+ TAX}$	B · A / 100 $\boxed{TAX}$
(4)	B	B
	$\boxed{- TAX}$	B / (1 + A / 100) $\boxed{- TAX}$
	$\boxed{- TAX}$	B - B / (1 + A / 100) $\boxed{TAX}$
	$\boxed{- TAX}$	B / (1 + A / 100) $\boxed{- TAX}$
	$\boxed{- TAX}$	B - B / (1 + A / 100) $\boxed{TAX}$

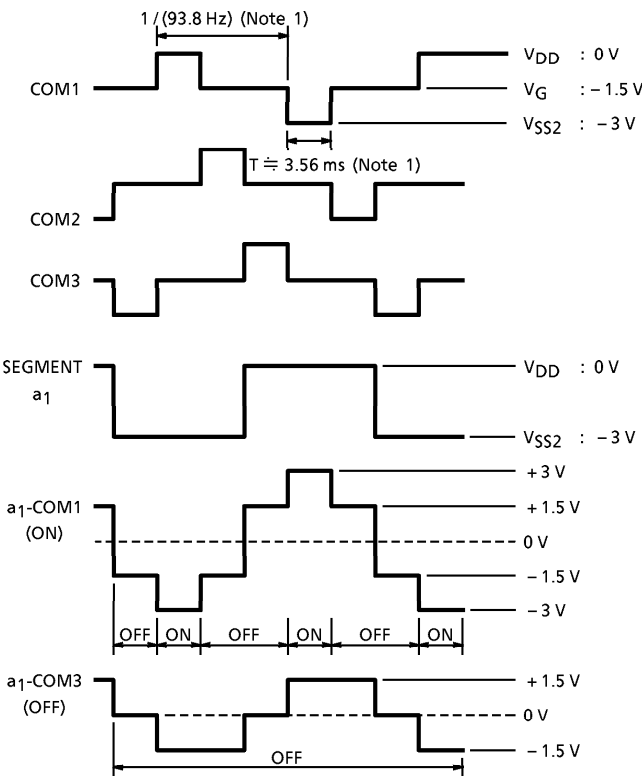
MAXIMUM RATINGS

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

ELECTRICAL CHARACTERISTICS ($V_G = -1.5 \pm 0.2$ V, $V_{SS2} = -3.0 \pm 0.4$ V, $V_{DD} = 0$ V, $T_a = 25^\circ\text{C}$)

CHARACTERISTICS	SYMBOL	TEST CIRCUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage	V_G	—	—	—	-1.2	-1.5	-2.0	V
"1" Input Voltage	$V_{IH}(1)$	—	K3~K10 RESET	—	$V_G + 0.4$	—	V_G	V
"1" Input Voltage	$V_{IH}(2)$	—	K11~K14	—	$V_{SS2} + 0.4$	—	V_{SS2}	V
"0" Input Voltage	V_{IL}	—	K3~K14 RESET	—	0	—	-0.4	V
"1" Output Voltage	$V_{OH}(1)$	—	SEGMENT COM1~3	—	$V_{SS2} + 0.2$	—	V_{SS2}	V
"0" Output Voltage	$V_{OL}(1)$	—	SEGMENT COM1~3	—	0	—	-0.2	V
"M" Output Voltage	V_{OM}	—	COM1~3	—	$V_G + 0.2$	—	$V_G - 0.2$	V
"1" Output Voltage	$V_{OH}(2)$	—	K1~K10	—	$V_G + 0.2$	—	V_G	V
"0" Output Voltage	$V_{OL}(2)$	—	K1~K14	—	0	—	-0.2	V
"1" Output Resistance	R_{OH}	—	SEGMENT COM1~3	$V_{OUT} = V_{SS2} + 0.5$ 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	$V_{OUT} = 0$ V	156	—	364	k Ω
	$R_{KEYH}(2)$	—	K1~K10	$V_{OUT} = 0$ V	240	—	560	
Key Read Pull Up Resistance	$R_{KEYH}(3)$	—	K1~K10	$V_{OUT} = 0$ V	30	—	600	k Ω
Key Pull Down Resistance	$R_{KEYL}(1)$	—	RESET K1~K10	$V_{OUT} = -0.5$ V	—	—	10	k Ω
	$R_{KEYL}(2)$	—	K11~K14	$V_{OUT} = V_{SS2}$	120	—	800	
Oscillating Frequency	(WAIT)	$f_{\phi WAIT}$	—	$V_G = -1.5$ V	5.4	9.0	12.6	kHz
	(OPERATE)	$f_{\phi OP}$	—	$V_G = -1.5$ V	28.8	48	67.2	
Frame Frequency	f_F	—	SEGMENT COM1~3	$V_G = -1.5$ V	56.3	93.8	131	Hz
Supply Current	1 (WAIT)	I_{DDWAIT}	—	$V_G = -1.5$ V	—	2.2	3.4	μA
	2 (OPERATE)	I_{DDOP}	—	$V_G = -1.2$ V	—	7.0	11.0	
	3 (OFF)	I_{DDOFF}	—	$V_G = -1.5$ V	—	—	2.0	
Power Off Timer Times	T	—	—	$V_G = -1.5$ V	429	600	1001	s

WAVEFORMS FOR DISPLAY



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

PAD LOCATION TABLE

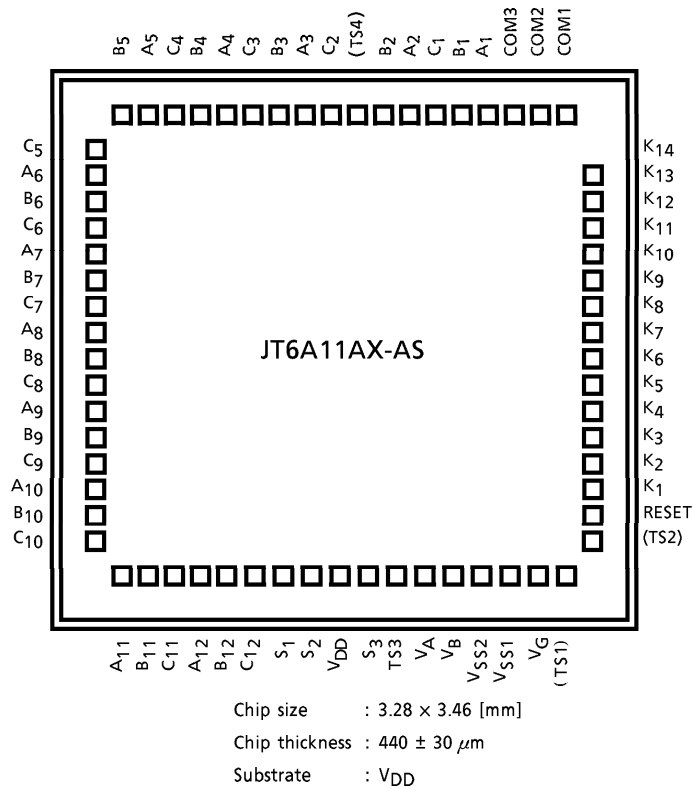
NAME	X POINT	Y POINT
V _{SS1}	971	- 1469
V _{SS2}	775	- 1469
V _B	609	- 1469
V _A	424	- 1469
TS3	252	- 1469
S ₃	100	- 1469
V _{DD}	- 52	- 1469
S ₂	- 203	- 1469
S ₁	- 355	- 1469
C ₁₂	- 507	- 1469
B ₁₂	- 659	- 1469
A ₁₂	- 810	- 1469
C ₁₁	- 980	- 1469
B ₁₁	- 1162	- 1469
A ₁₁	- 1358	- 1469
C ₁₀	- 1408	- 1193
B ₁₀	- 1408	- 1042
C ₁₀	- 1408	- 890
C ₉	- 1408	- 738
B ₉	- 1408	- 586
A ₉	- 1408	- 435
C ₈	- 1408	- 283
B ₈	- 1408	- 131
A ₈	- 1408	20
C ₇	- 1408	172
B ₇	- 1408	324
A ₇	- 1408	475
C ₆	- 1408	627
B ₆	- 1408	779
A ₆	- 1408	936
C ₅	- 1408	1119
B ₅	- 1358	1469
A ₅	- 1169	1469

(μm)

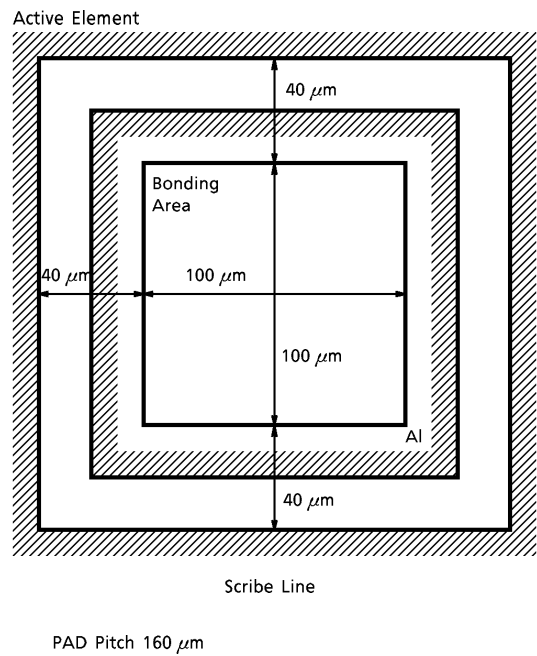
NAME	X POINT	Y POINT
C ₄	- 999	1469
B ₄	- 847	1469
A ₄	- 696	1469
C ₃	- 544	1469
B ₃	- 392	1469
A ₃	- 240	1469
C ₂	- 89	1469
(TS4)	89	1469
B ₂	241	1469
A ₂	392	1469
C ₁	544	1469
B ₁	696	1469
A ₁	847	1469
COM3	999	1469
COM2	1166	1469
COM1	1358	1469
K ₁₄	1408	1175
K ₁₃	1408	1023
K ₁₂	1408	871
K ₁₁	1408	720
K ₁₀	1408	503
K ₉	1408	352
K ₈	1408	200
K ₇	1408	48
K ₆	1408	- 104
K ₅	1408	- 255
K ₄	1408	- 407
K ₃	1408	- 559
K ₂	1408	- 710
K ₁	1408	- 862
RESET	1408	- 1023
(TS2)	1408	- 1175
(TS1)	1367	- 1469
V _G	1160	- 1469

(Note) : () Do not connect.

CHIP LAYOUT



PAD LAYOUT



QFP67-P-1420-0.80

Technical drawing of a rectangular PCB layout. The overall dimensions are 24.1 ± 0.4 (width) and 18.1 ± 0.4 (height). The internal dimensions are 20.0 ± 0.2 (width) and 14.0 ± 0.2 (height). The layout includes several rows of component footprints, labeled with numbers: 54, 33, 55, 67, 32, 22, 1, 21, and 0.8. The spacing between components is specified as 2.0 TYP, 1.2 TYP, 3.8 TYP, 2.2 TYP, 2.0 TYP, 0.3 ± 0.1, and 0.8. The drawing also shows a cross-section view of the component footprints, indicating a thickness of 0.15 ± 0.1 and a maximum height of 2.25 MAX. The cross-section view shows a component with a thickness of 1.85 ± 0.2 and a width of 1.35 ± 0.2. The component is mounted on a substrate with a thickness of 0.2 ± 0.1.

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