

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

T6A36S, JT6A36X-AS

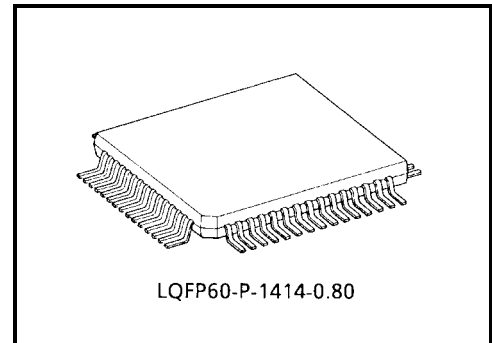
T6A36S, JT6A36X-AS CMOS Single-Chip LSI for LCD Calculator

The T6A36S, JT6A36X-AS is a single-chip microcomputer for 8-digit 1-memory calculator.

T6A36S, JT6A36X-AS can drive the liquid crystal display (LCD). Single power supply operation, low-power consumption make it suitable for single battery operated pocketable calculator.

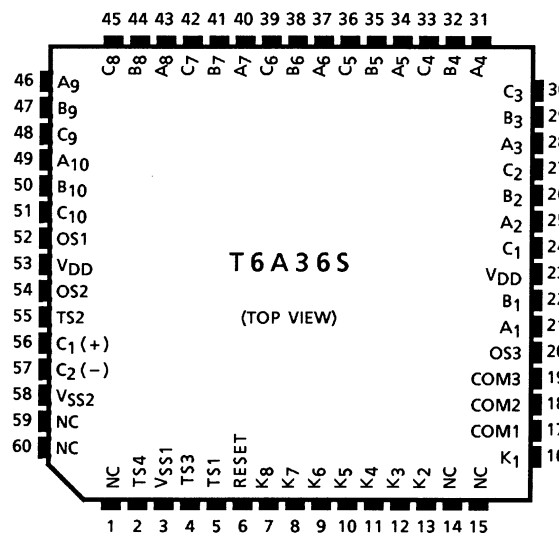
Features

- 8 digits of data and one symbol digit for calculator.
- Algebraic calculation mode.
- Punctuation.
- Standard 4 functions (+, -, ×, ÷), mark up percent with automatic add-on/discount, automatic constant calculations, chain 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 (-1.5 V typ.).
- Quad in line flat package (60 pin).
- Very low-power consumption (3.0 μW typ. at wait).
- Very wide range of operating voltage (VSS = -1.2~-2.0 V).
- Automatic power off (A time for about 7 min).



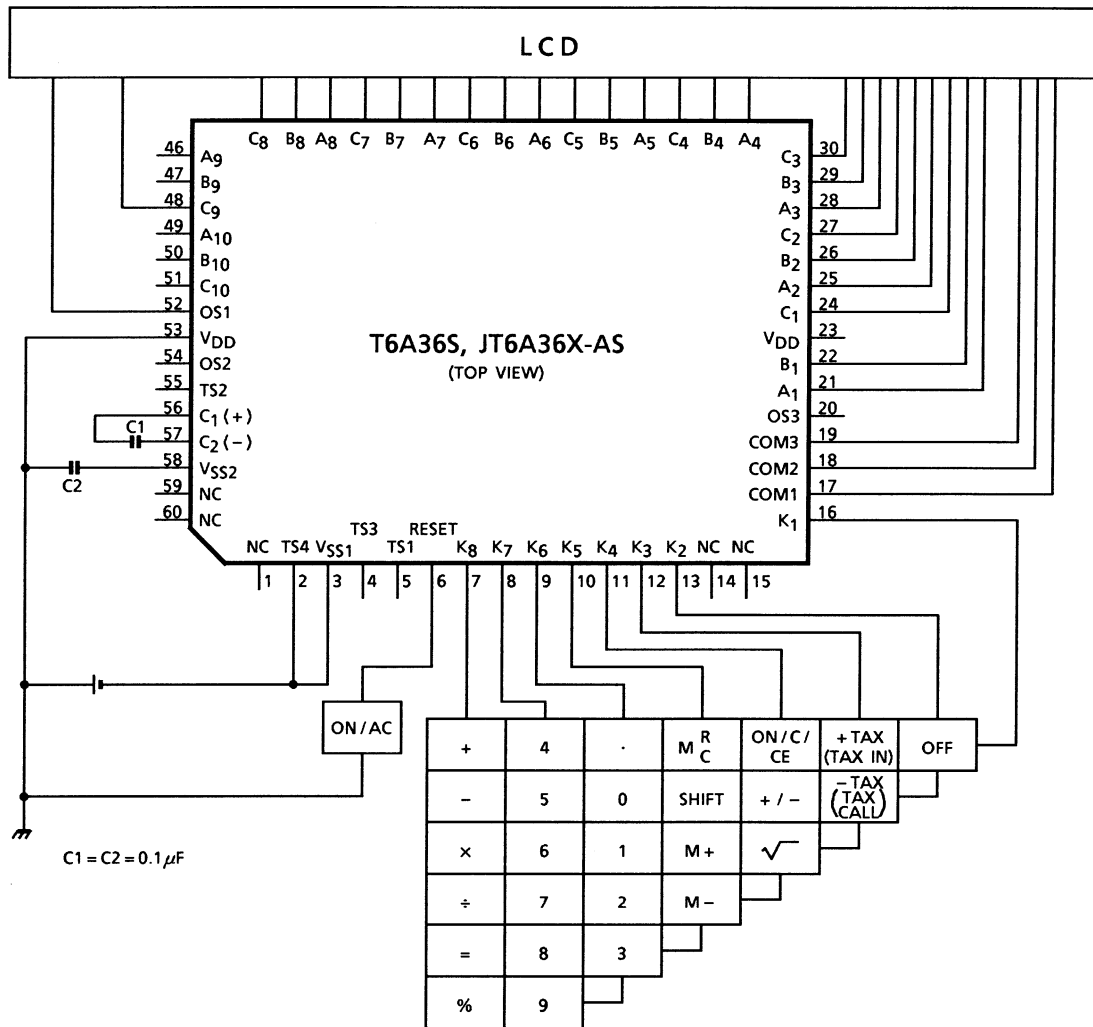
Weight: 0.66 g (typ.)

Pin Assignment (top view)



System Block Diagram

Battery Type

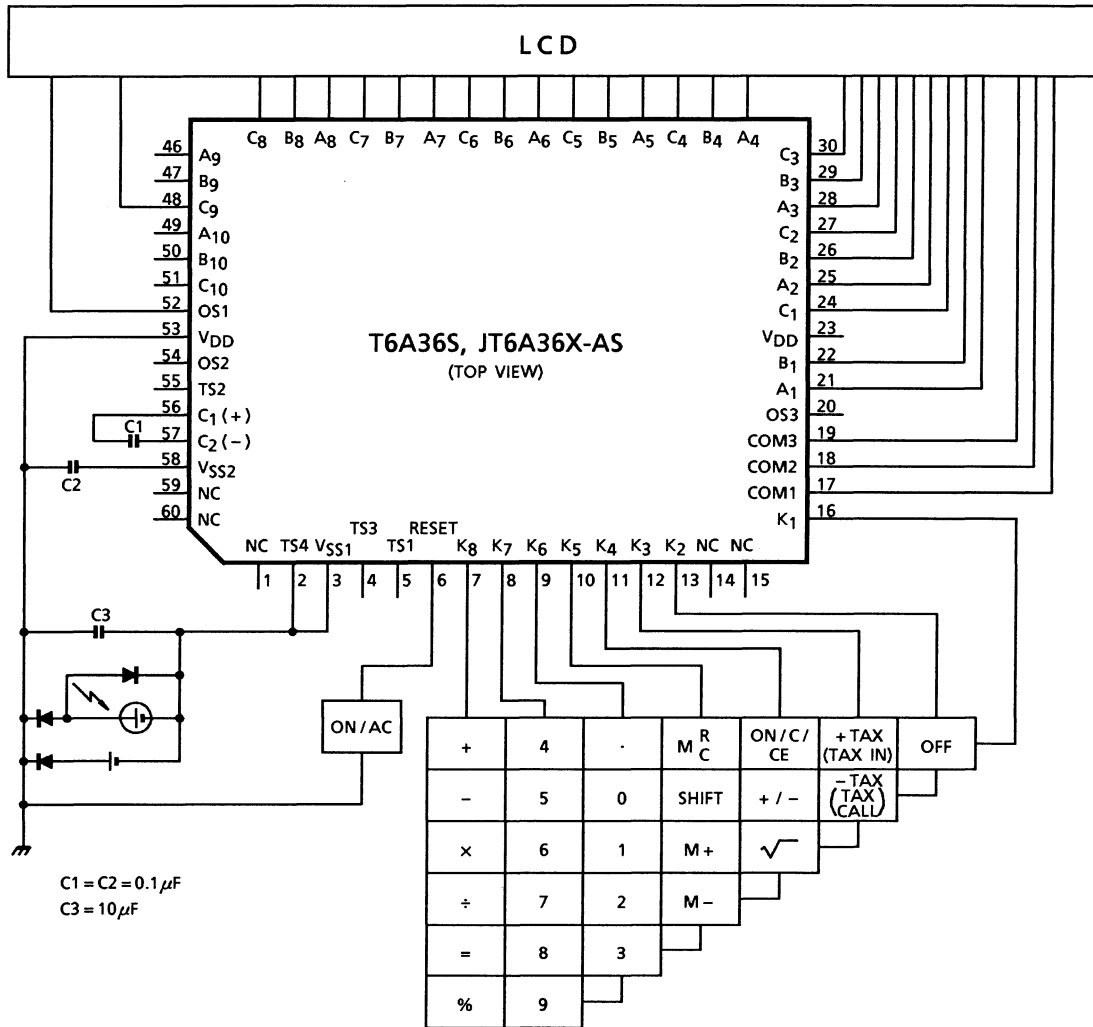


Note 1:

TS4 { VDD OFF mode disable
 VSS1 OFF mode enable

Rkey ≤ 20 kΩ (-1.2 V)

Dual Type

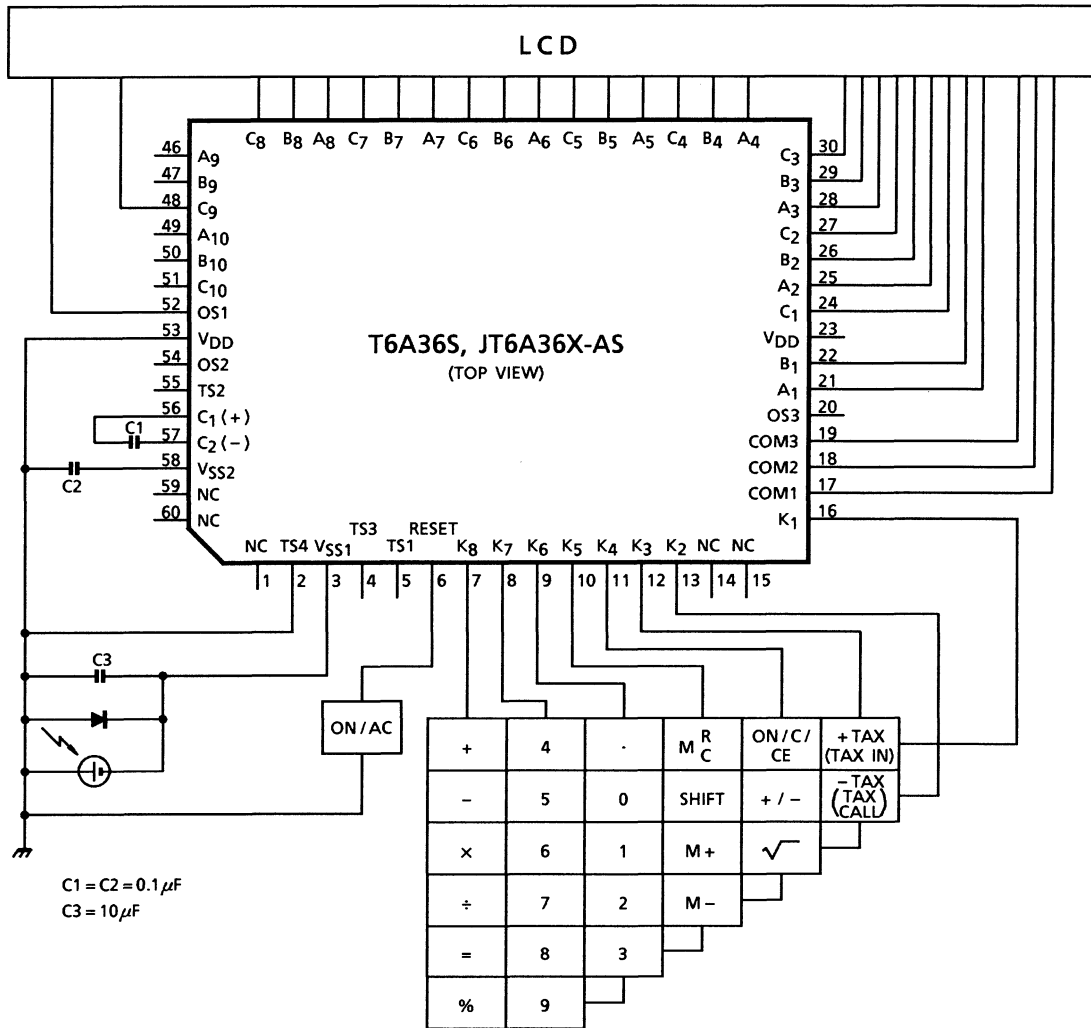


Note 2:

TS₄ { VDD OFF mode disable
 VSS₁ OFF mode enable

Rkey ≤ 20 kΩ (-1.2 V)

Solar Type



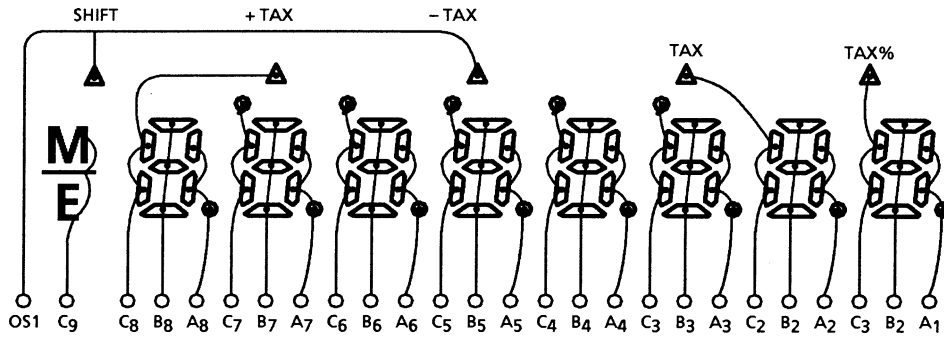
Note 3:

TS4 { VDD OFF mode disable
 VSS1 OFF mode enable

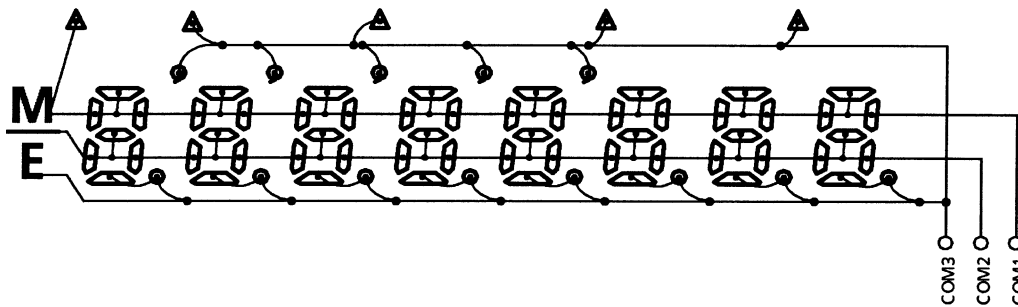
Rkey ≤ 20 kΩ (-1.2 V)

Connection of LCD

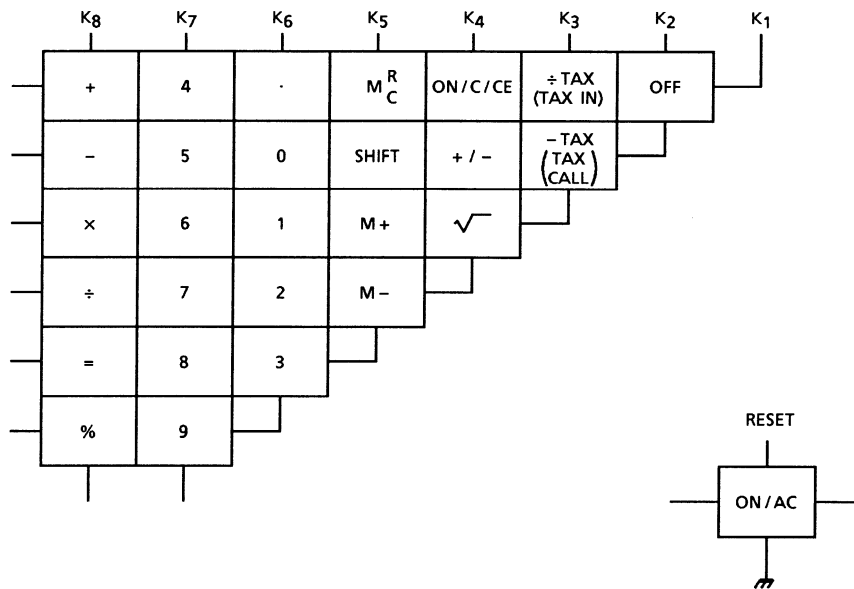
Segment



Common



Key Connection



Specification of Calculator

Operational Features

- (1) 8 digits of data and one symbol digit.
- (2) Algebraic mode.
- (3) Full floating point.
- (4) Standard 4 functions +, -, ×, ÷.
- (5) Memory calculation and memory hold.
- (6) TAX calculation.
- (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

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

	Key Op.	Display
(1)	A	A
	$\boxed{-}$	A
	B	B
	$\boxed{-}$	A - B
	C	C
	$\boxed{=}$	A - B - C
	$\boxed{-}$	A - B - C
	D	D
	$\boxed{+ / -}$	-D
	$\boxed{-}$	A - B - C + D
	$\boxed{=}$	-(A - B - C + D)

3. Multiplication

	Key Op.	Display
(1)	A	A
	$\boxed{\times}$	A
	B	B
	$\boxed{=}$	A·B
	$\boxed{+}$	A·B
	C	C
	$\boxed{=}$	A·B + C
(2)	$\boxed{-}$	0.
	A	A
	$\boxed{\times}$	-A
	B	B
	$\boxed{=}$	-A·B

4. Division

	Key Op.	Display
(1)	A	A
	\div	A
	B	B
(2)	$=$	A / B
	$-$	0.
	A	A.
	\div	-A
	B	B
	$=$	-A / B

5. Power Calculation

	Key Op.	Display
(1)	A	A
	\times	A
	$=$	A^2
	$=$	A^3
(2)	A	A
	\div	A
	$=$	1 / A
	$=$	1 / A^2
(3)	$-$	0.
	A	A
	\times	-A
	$=$	A^2
	$=$	$-A^3$
(4)	$-$	0.
	A	A
	\div	-A
	$=$	-1 / A
	$=$	1 / A^2
(5)	A	A
	\times	A
	$=$	A^2
	\times	A^2
	$=$	A^4

6. Mixed Calculation

	Key Op.	Display
(1)	A	A
	$\boxed{\times}$	A
	B	B
	$\boxed{+}$	A·B
	C	C
	$\boxed{\div}$	A·B + C
	D	D
	$\boxed{-}$	$\frac{A \cdot B + C}{D}$
	E	E
	$\boxed{=}$	$\frac{A \cdot B + C}{D} - E$

7. Constant Calculation

	Key Op.	Display
(1)	A	A
	\times	A
	B	B
	$=$	A·B
	C	C
(2)	$=$	A·C
	$-$	0.
	A	A
	\times	-A
	B	B
(3)	$=$	-A·B
	C	C
	$=$	-A·C
	A	A
	\div	A
(4)	B	B
	$=$	A/B
	C	C
	$=$	C/B
	D	D
(5)	\times	D
	$=$	D ²
	A	A
	$+$	A
	B	B
(6)	$=$	A + B
	C	C
	$=$	C + B
	A	A
	$-$	A
(7)	B	B
	$=$	A - B
	C	C
	$=$	C - B

	Key Op.	Display
(6)	A	A
	\times	A
	B	B
	$=$	A·B
	C	C
	\times	C
	D	D
	$=$	C·D
	E	E
	$=$	C·E
	\times	C·E
	F	F
	$=$	C·E·F
	G	G
	\div	G
	H	H
$=$	G/H	
I	I	
$=$	I/H	
(7)	A	A
	\times	A
	B	B
	$\%$	A·B / 100
	C	C
	$\%$	A·C / 100
	D	D
	\div	D
	E	E
	$\%$	100·D / E
F	F	
$\%$	100·F / E	

8. Mark-up/Discount Calculator

	Key Op.	Display
(1)	A	A
	\times	A
	B	B
	$+$	$A \cdot B$
	$=$	$A + A \cdot B$
(2)	A	A
	\times	A
	B	B
	$-$	$A \cdot B$
	$=$	$A - A \cdot B$
(3)	A	A
	\times	A
	B	B
	$\%$	$A \cdot B / 100$
	$+$	$A \cdot B / 100$
	$=$	$A + A \cdot B / 100$
(4)	A	A
	\times	A
	B	B
	$\%$	$A \cdot B / 100$
	$-$	$A \cdot B / 100$
	$=$	$A - A \cdot B / 100$
(5)	A	A
	$+$	A
	B	B
	$\%$	$A + A \cdot B / 100$
(6)	A	A
	$-$	A
	B	B
	$\%$	$A - A \cdot B / 100$

9. Memory Calculation

	Key Op.	Display	Memory
(1)	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
	$\boxed{M^R_C}$	A + B - C (M)	A + B - C
	$\boxed{M^R_C}$	A + B - C	0.
	(2)	A	A
$\boxed{+}$		A	0.
B		B	0.
$\boxed{M+}$		A + B (M)	A + B
$\boxed{+}$		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)	A · B - C · D
	$\boxed{M^R_C}$	A · B - C · D (M)	A · B - C · D
	$\boxed{M-}$	A · B - C · D	0.

	Key Op.	Display	Memory
(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
	$\boxed{M^R_C}$	A + B (M)	A + B
	$\boxed{\times}$	A + B (M)	A + B
	$\boxed{M^R_C}$	A + B (M)	A + B
	$\boxed{+}$	(A + B) ² (M)	A + B
	C	C (M)	A + B
	$\boxed{=}$	(A + B) ² + C (M)	A + B
(6)	1.0000001	1.0000001	0.
	$\boxed{M+}$	1.0000001 (M)	1.0000001
	99999999	99999999. (M)	1.0000001
	$\boxed{M+}$	0. ($\frac{M}{E}$)	1.0000001
	$\boxed{ON/C/CE}$	0. (M)	1.0000001
	$\boxed{M^R_C}$	1.0000001 (M)	1.0000001

10. Square Root

	Key Op.	Display	Memory
(1)	A	A	
	$\sqrt{\square}$	\sqrt{A}	
(2)	B	B	
	A	A	
	\times	A	
	B	B	
	$\sqrt{\square}$	\sqrt{B}	
(3)	$=$	$A\sqrt{B}$	
	A	A	
	\times	A	
	$\sqrt{\square}$	\sqrt{A}	
	B	B	
(4)	$=$	$A \cdot B$	
	$-$	0.	
	A	A	
	$=$	-A	
	$\sqrt{\square}$	$\sqrt{A (E)}$	
(5)	A	A	0.
	$M+$	A (M)	A
	M^R_C	A (M)	A
	\div	A (M)	A
	B	B (M)	A
	$+ / -$	-B (M)	A
	$\sqrt{\square}$	$\sqrt{B (M)}$ E	A
	$ON/C/CE$	0. (M)	A

11. Percentage Calculation

	Key Op.	Display	Memory
(1)	A	A	
	$\boxed{\times}$	A	
	B	B	
	$\boxed{\%}$	$A \cdot B / 100$	
	C	C	
	$\boxed{\%}$	$A \cdot C / 100$	
	D	D	
	$\boxed{\%}$	$A \cdot D / 100$	
	(2)	A	A
$\boxed{\%}$		A	
B		B	
$\boxed{\%}$		B	
C		C	
$\boxed{\%}$		C	
(3)	A	A	
	$\boxed{-}$	A	
	B	B	
	$\boxed{\%}$	$A - A \cdot B / 100$	
	$\boxed{-}$	$A - A \cdot B / 100$	
	$\boxed{+}$	$A - A \cdot B / 100$	
	C		
	$\boxed{\%}$	$\left(A - \frac{A \cdot B}{100}\right) + \frac{\left(A - \frac{A \cdot B}{100}\right) \cdot C}{100}$	

12. Key Correction

	Key Op.	Display	Memory
(1)	A	A	0.
	\times	A	0.
	\div	A	0.
	-	A	0.
	+	A	0.
	$\sqrt{\quad}$	\sqrt{A}	0.
	M+	$A + \sqrt{A} (M)$	$A + \sqrt{A}$
	+ / -	$- (A + \sqrt{A}) (M)$	$A + \sqrt{A}$
	M_C^R	$A + \sqrt{A} (M)$	$A + \sqrt{A}$
	M_C^R	$A + \sqrt{A} (M)$	0.
	B	B	0.
	+	B	0.
	-	B	0.
	\times	B	0.
	\div	B	0.
	=	1 / B	0.

13. Others

	Key Op.	Display	Memory
(1)	A	A	
	+	A	
	=	A	
(2)	A	A	
	\times	A	
	\div	A	
	=	1 / A	
(3)	A	A	
	\div	A	
	+	A	
	=	A	

	Key Op.	Display	Memory
(4)	A	A	
	\times	A	
	$-$	A	
	$=$	-A	
(5)	A	A	
	\div	A	
	$-$	A	
	$=$	-A	
(6)	A	A	
	\times	A	
	ON/C/CE	0.	
	B	B	
	$=$	B	
(7)	A	A	
	\times	A	
	B	B	
	ON/C/CE	0.	
	C	C	
	$=$	A·C	

14. TAX Calculation

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

Maximum Characteristics

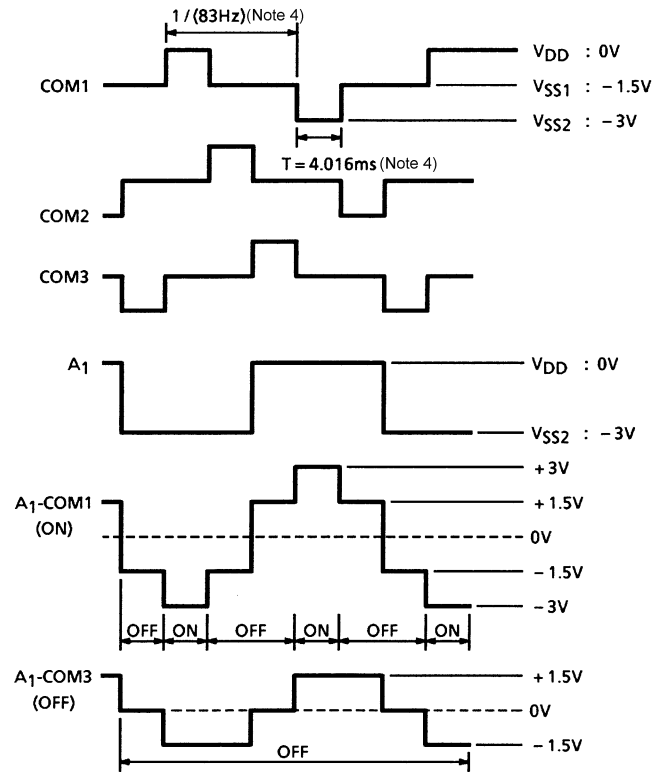
Characteristics	Symbol	Rating	Unit
Supply voltage	V_{SS1}	+0.3~-2.2	V
Input voltage	V_{IN}	+0.3~ V_{DD1} -0.3	V
Operating temperature	T_{opr}	+0.0~40	°C
Storage temperature	T_{stg}	-55~125	°C

Electrical Characteristics

($V_{SS1} = -1.5 \text{ V} \pm 0.2 \text{ V}$, $V_{SS2} = -3.0 \text{ V} \pm 4.0 \text{ V}$, $V_{DD} = 0 \text{ V}$, $T_a = 25^\circ\text{C}$)

Characteristics	Symbol	Test Circuit	Pin Name	Test Condition	Min	Typ.	Max	Unit	
Operating voltage	V_{SS1}	—	—	—	-1.2	-1.5	-2.0	V	
Voltage	Input "1"	V_{IH}	K2~K8, RESET	—	$V_{SS1} + 0.4$	—	V_{SS1}	V	
	Input "0"	V_{IL}	K2~K8, RESET	—	0	—	-0.4	V	
	Onput "1"	V_{OH}	Segment, Common	—	$V_{SS2} + 0.2$	—	V_{SS2}	V	
	Output "0"	V_{OL}	Segment, Common	—	0	—	-0.2	V	
	Output "1"	V_{OH}	K1~K8, RESET	—	$V_{SS1} + 0.2$	—	V_{SS1}	V	
	Output "0"	V_{OL}	K1~K6, RESET	—	0	—	-0.2	V	
Resistance	Output "1"	R_{OH}	Segment	$V_{OUT} = V_{DD2} + 0.5 \text{ V}$	—	—	70	$k\Omega$	
	Output "0"	R_{OL}	Segment	$V_{OUT} = -0.5 \text{ V}$	—	—	70	$k\Omega$	
	Output "1"	R_{OH}	Common	$V_{OUT} = V_{DD2} + 0.5 \text{ V}$	—	—	70	$k\Omega$	
	Output "0"	R_{OL}	Common	$V_{OUT} = -0.5 \text{ V}$	—	—	70	$k\Omega$	
	Pull up	R_{KH}	—	K1~K8	$V_{OUT} = 0 \text{ V}$	60	400	1500	$k\Omega$
		RESET	—	RESET	$V_{OUT} = 0 \text{ V}$	200	300	400	
Output "0"	R_{OL}	—	K1~K6	$V_{OUT} = -0.5 \text{ V}$	—	—	10	$k\Omega$	
Supply current 1 (on display)	I_{DD1}	—	—	$V_{SS1} = -1.5 \text{ V}$ (no keys)	—	-2.2	-3.6	μA	
Supply current 2 (operation)	I_{DD2}	—	—	$V_{SS1} = -1.2 \text{ V}$ (peak OF A11 $9\sqrt{\text{ }}$)	—	-4.4	-6.6	μA	
Supply current 3 (off)	I_{DD3}	—	—	$V_{SS1} = -1.5 \text{ V}$ (off status)	—	-0.5	-2.0	μA	
Oscillating frequency	fosc (WAIT)	—	—	$V_{SS1} = -1.5 \text{ V}$	On Display	5.4	9	12.6	$k\text{Hz}$
	fosc (OP)	—	—		On Operating	10.8	18	25.2	
Frame frequency	f_F	—	—	$V_{SS1} = -1.5 \text{ V}$ (wait)	50	83	117	Hz	
Power off timer	T timer	—	—	$V_{SS1} = -1.5 \text{ V}$	252	420	588	s	

Waveforms for Display



Note 4: $f_{\phi} = 9\text{ kHz}$

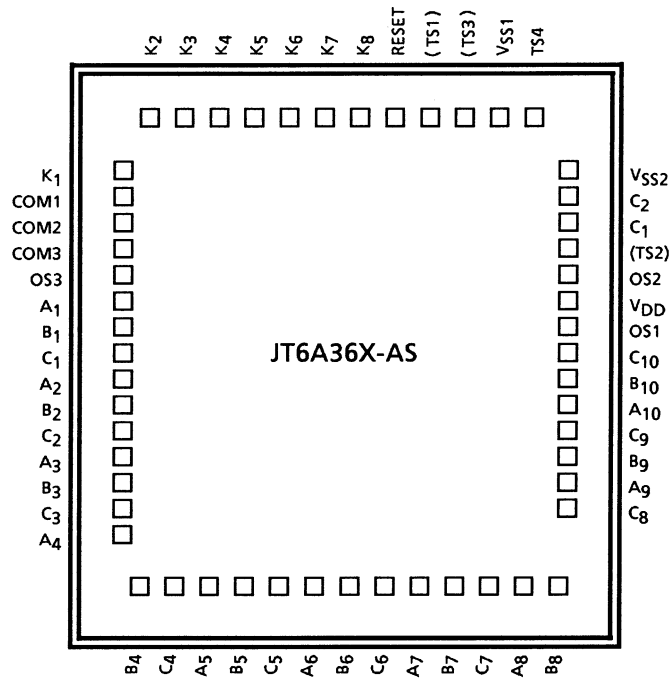
Pad Location Table

(μm)

Name	X Point	Y Point
TS4	779	1086
V _{SS1}	628	1086
TS3	476	1086
TS1	324	1086
RESET	172	1086
K ₈	21	1086
K ₇	-131	1086
K ₆	-283	1086
K ₅	-434	1086
K ₄	-586	1086
K ₃	-738	1086
K ₂	-889	1086
K ₁	-1462	931
COM1	-1462	733
COM2	-1462	581
COM3	-1462	430
OS3	-1462	278
A ₁	-1462	126
B ₁	-1462	-26
C ₁	-1462	-177
A ₂	-1462	-329
B ₂	-1462	-481
C ₂	-1462	-632
A ₃	-1462	-784
B ₃	-1462	-936
C ₃	-1462	-1087
A ₄	-1462	-1239

Name	X Point	Y Point
B ₄	-1097	-1412
C ₄	-946	-1412
A ₅	-794	-1412
B ₅	-642	-1412
C ₅	-491	-1412
A ₆	-339	-1412
B ₆	-187	-1412
C ₆	-36	-1412
A ₇	116	-1412
B ₇	268	-1412
C ₇	420	-1412
A ₈	571	-1412
B ₈	723	-1412
C ₈	1084	-1240
A ₉	1084	-1088
B ₉	1084	-936
C ₉	1084	-785
A ₁₀	1084	-633
B ₁₀	1084	-481
C ₁₀	1084	-330
OS1	1084	-178
V _{DD}	1084	-26
OS2	1084	125
TS2	1084	326
C ₁ (+)	1084	534
C ₂ (-)	1084	735
V _{SS2}	1084	937

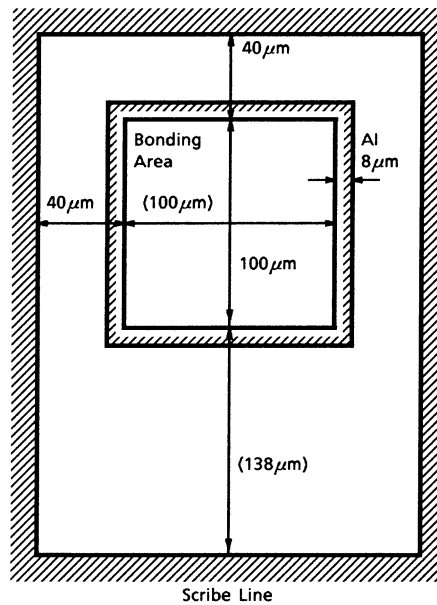
Chip Layout



Chip size : 3.04 × 3.02 [mm]
 Chip thickness : 440 ± 30 [μm]
 Substrate : V_{DD}

Pad Layout

Active Element

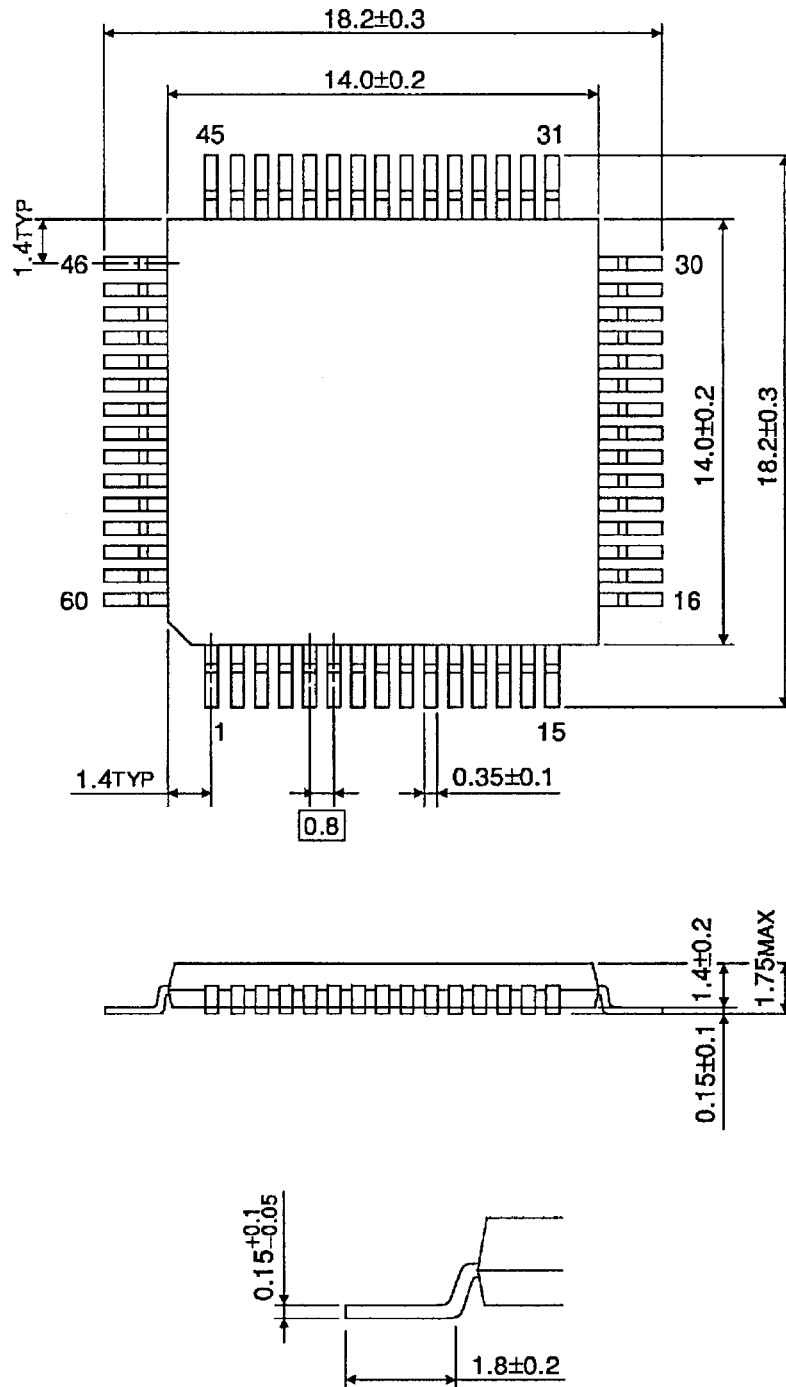


PAD Pitch 151 μm

Package Dimensions

LQFP60-P-1414-0.80

Unit : mm



Weight: 0.66 g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

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