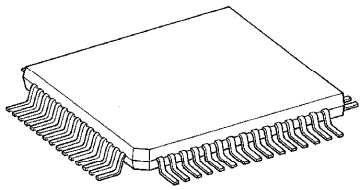
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



LQFP60-P-1414-0.80

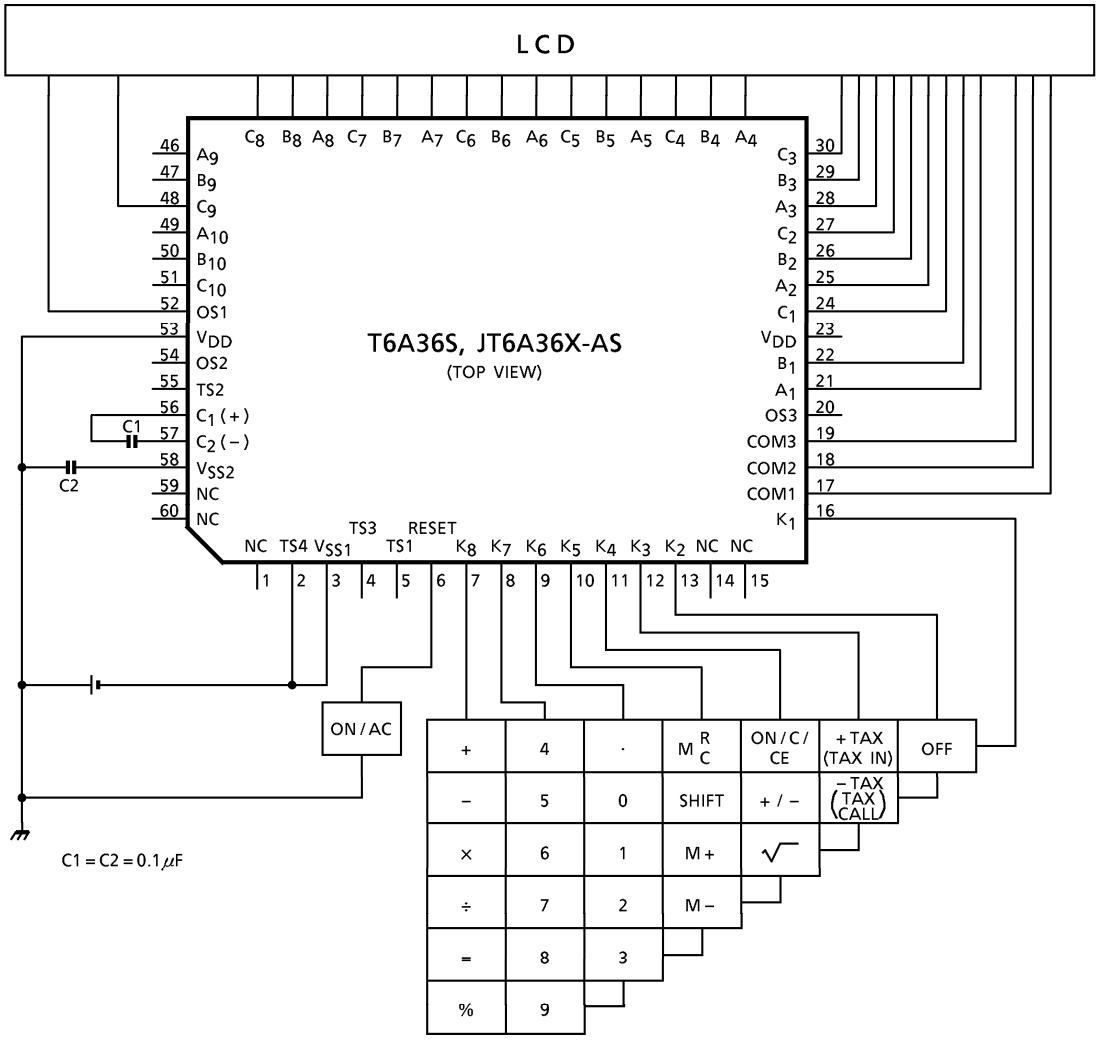
Weight : 0.66g (Typ.)

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, memory calculations with memory overflow protection.
- Internal keyboard decoding and denouncing.
- Complementary output buffer for direct driving of liquid crystal display (LCD : FEM type −3.0V, 1/2 bias, 1/3 duty).
- Single power supply (−1.5V typ.).
- Quad in line flat package (60 PIN).
- Very low-power consumption (3.0μW typ. at wait).
- Very wide range of operating voltage (V_{SS} = −1.2~ −2.0V).
- Automatic power off (A time for about 7 min.).

SYSTEM BLOCK DIAGRAM

Battery Type

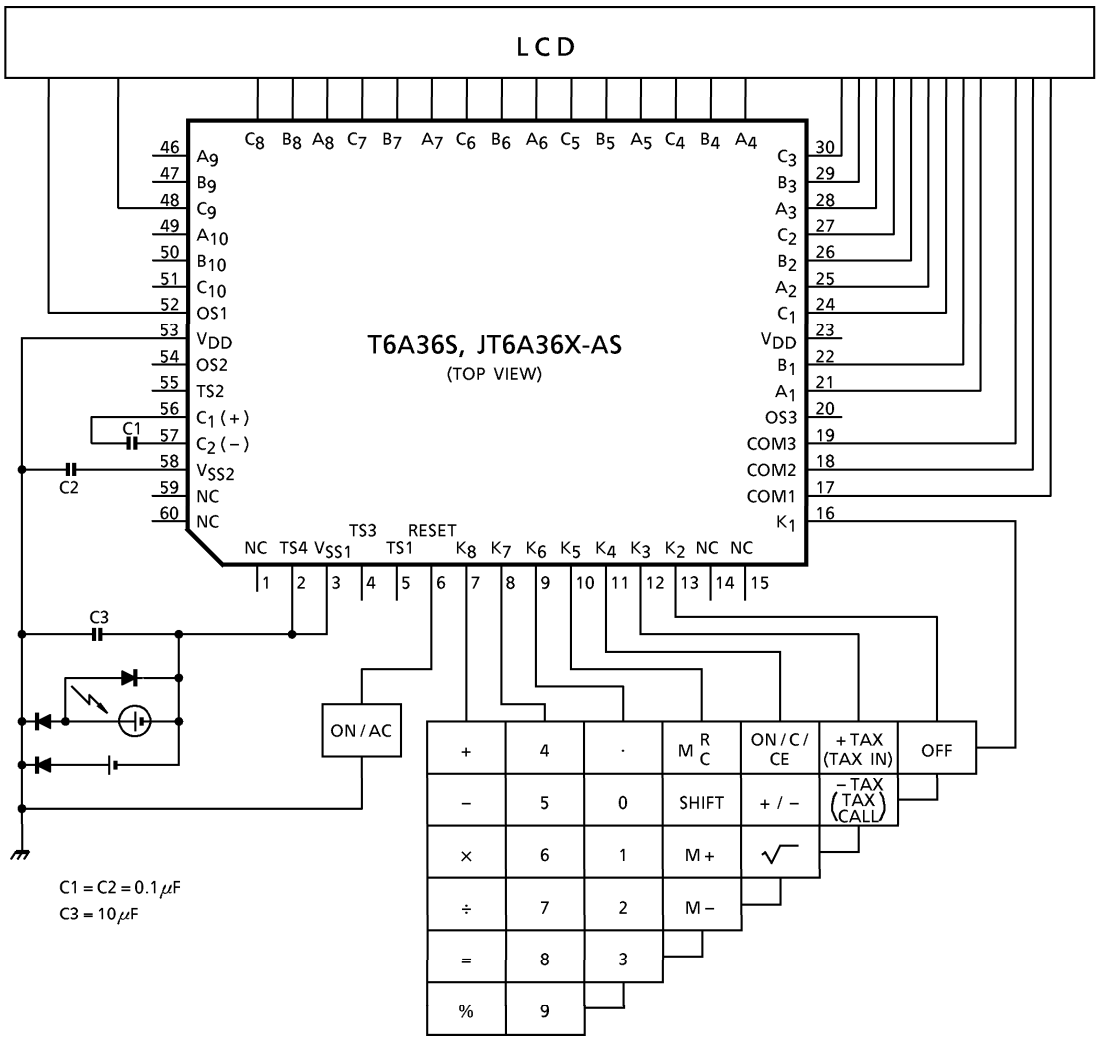


[NOTE]

TS4 { V_{DD} ····· OFF MODE DISABLE
TS4 { V_{SS1} ····· OFF MODE ENABLE

Rkey ≦ 20kΩ (− 1.2V)

Dual Type

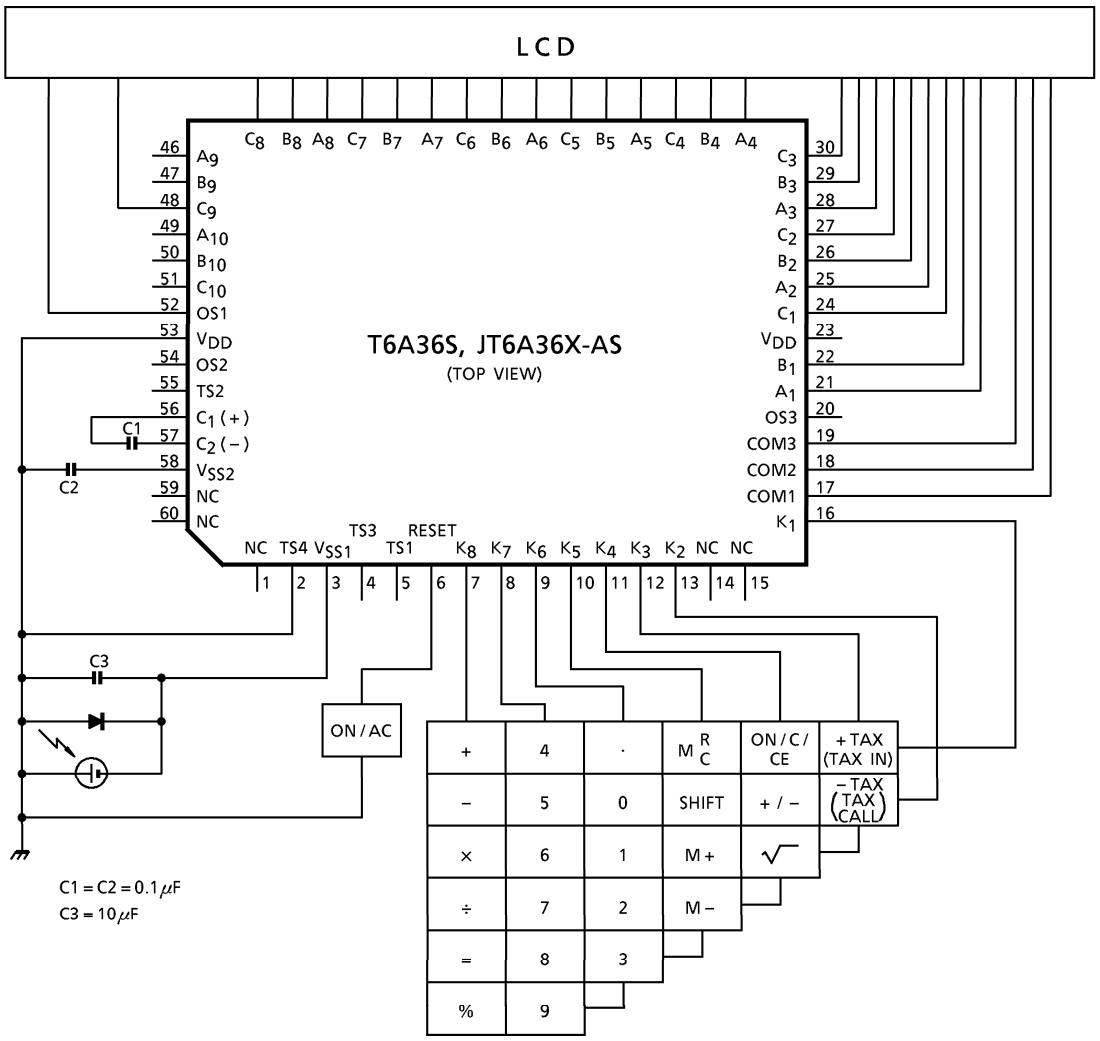


[NOTE]

TS4 { V_{DD} ····· OFF MODE DISABLE
TS4 { V_{SS1} ····· OFF MODE ENABLE

Rkey ≦ 20kΩ (− 1.2V)

Solar Type



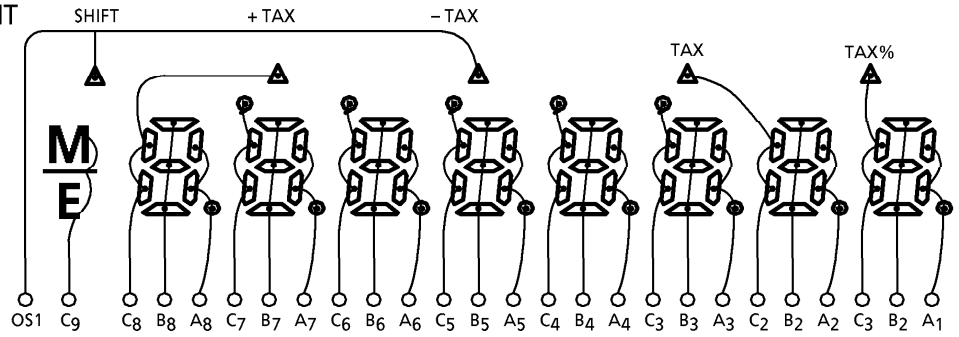
[NOTE]

TS4 { V_{DD} ····· OFF MODE DISABLE
V_{SS1} ····· OFF MODE ENABLE

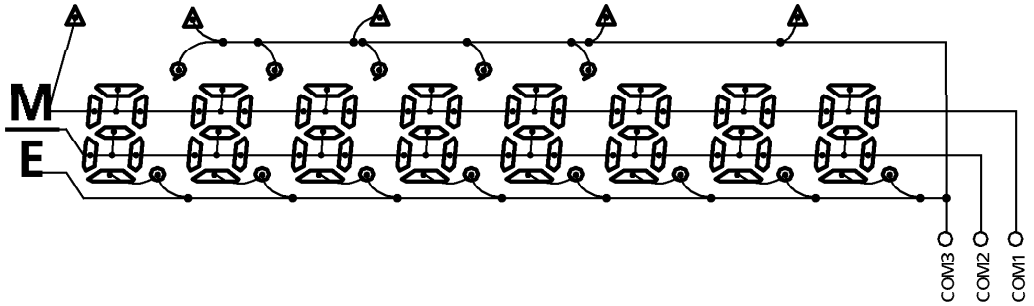
Rkey ≦ 20kΩ (– 1.2V)

CONNECTION OF LCD

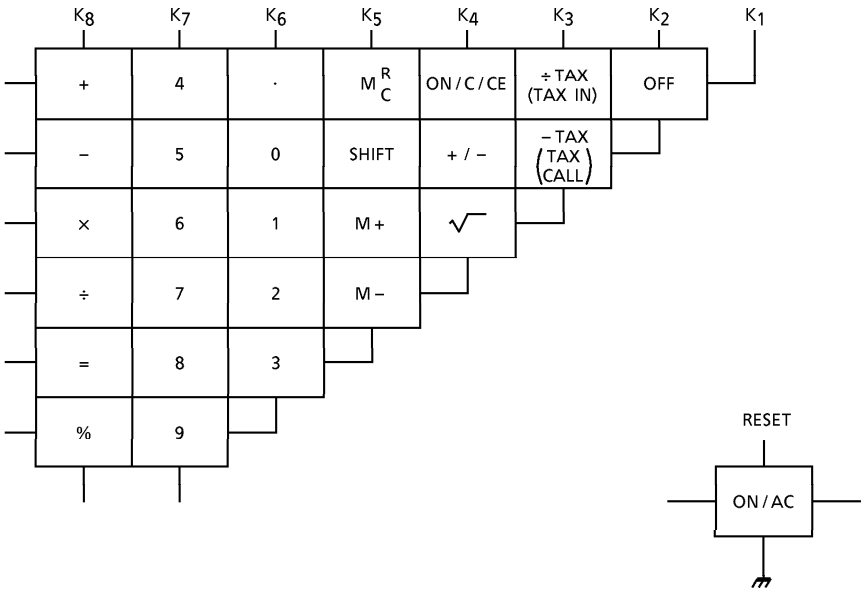
SEGMENT



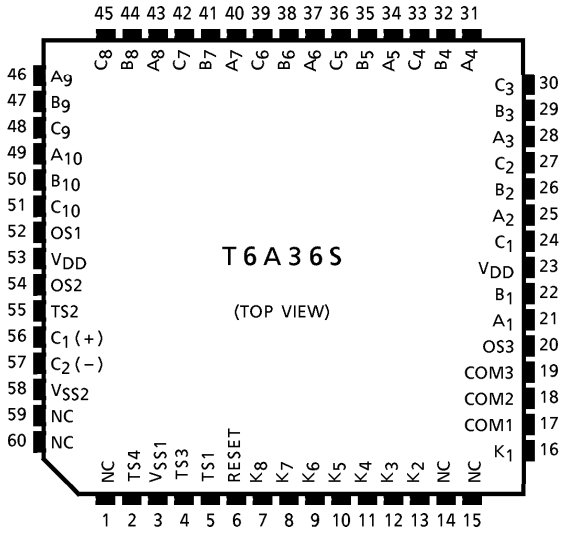
COMMON



KEY CONNECTION



PIN ASSIGNMENT



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.

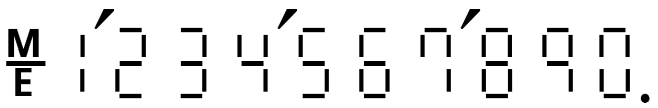
(12) Square root.

(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
[+]	A
B	B
[+]	A + B
C	C
[=]	A + B + C
D	D
[+]	D
E	E
[+]	D + E
[=]	D + E

2. Subtraction

	Key Op.	Display
(1)	A	A
	[−]	A
	B	B
	[−]	A − B
	C	C
	[=]	A − B − C
	[−]	A − B − C

		Key Op.	Display
		D	D
		[+ / −]	− D
		[−]	A − B − C + D
		[=]	− (A − B − C + D)

3. Multiplication

(1)	A	A
	[×]	A
	B	B
	[=]	A·B
	[+]	A·B
	C	C
	[=]	A·B + C
(2)	[−]	0.
	A	A
	[×]	− A
	B	B
	[=]	− A·B

4. Division

(1)	A	A
	[÷]	A
	B	B
	[=]	A / B
(2)	[−]	0.
	A	A.
	[÷]	− A
	B	B
	[=]	− A / B

5. Power calculation

	Key Op.	Display
(1)	A	A
	×	A
	=	A^2
	=	A^3
(2)	A	A
	÷	A
	=	1 / A
	=	$1 / A^2$
(3)	−	0.
	A	A
	×	− A
	=	A^2
	=	$-A^3$
(4)	−	0.
	A	A
	÷	− A
	=	− 1 / A
	=	$1 / A^2$
(5)	A	A
	×	A
	=	A^2
	×	A^2
	=	A^4

6. Mixed calculation

(1)	A	A
	×	A
	B	B
	+	A·B
	C	C

	Key Op.	Display
	÷	A·B + C
	D	D
	−	$\frac{A \cdot B + C}{D}$
	E	E
	=	$\frac{A \cdot B + C}{D} - E$

7. Constant calculation

(1)	A	A
	×	A
	B	B
	=	A·B
	C	C
	=	A·C
(2)	−	0.
	A	A
	×	− A
	B	B
	=	− A·B
	C	C
	=	− A·C
(3)	A	A
	÷	A
	B	B
	=	A / B
	C	C
	=	C / B
	D	D
	×	D
	=	D^2

	Key Op.	Display
(4)	A	A
	[+]	A
	B	B
	[=]	A + B
	C	C
	[=]	C + B
(5)	A	A
	[−]	A
	B	B
	[=]	A − B
	C	C
	[=]	C − B
(6)	A	A
	[×]	A
	B	B
	[=]	A·B
	C	C
	[×]	C
	D	D
	[=]	C·D
	E	E
	[=]	C·E
	[×]	C·E
	F	F
	[=]	C·E·F
	G	G
	[÷]	G
	H	H
	[=]	G / H

	Key Op.	Display
	I	I
	[=]	I / H
(7)	A	A
	[×]	A
	B	B
	[%]	A·B / 100
	C	C
	[%]	A·C / 100
	D	D
	[÷]	D
	E	E
	[%]	100·D / E
	F	F
	[%]	100·F / E

8. Mark-up / Discount calculator

(1)	A	A
	[×]	A
	B	B
	[+]	A·B
	[=]	A + A·B
(2)	A	A
	[×]	A
	B	B
	[−]	A·B
	[=]	A − A·B
(3)	A	A
	[×]	A
	B	B
	[%]	A·B / 100

	Key Op.	Display
	[+]	A·B / 100
	[=]	A + A·B / 100
(4)	A	A
	[×]	A
	B	B
	[%]	A·B / 100
	[−]	A·B / 100
	[=]	A − A·B / 100
(5)	A	A
	[+]	A
	B	B
	[%]	A + A·B / 100
(6)	A	A
	[−]	A
	B	B
	[%]	A − A·B / 100

9. Memory calculation

	Key Op.	Display	Memory
	A	A	0.
	[M+]	A (M)	A
	B	B (M)	A
	[M+]	B (M)	A + B
	C	C (M)	A + B
	[M−]	C (M)	A + B − C
	D	D (M)	A + B − C
	[MRC]	A + B − C (M)	A + B − C
	[MRC]	A + B − C	0.
(2)	A	A	0.
	[+]	A	0.

	Key Op.	Display	Memory
	B	B	0.
	[M+]	A + B (M)	A + B
	[+]	A + B (M)	A + B
	[M+]	A + B (M)	2 (A + B)
	C	C (M)	2 (A + B)
	[M−]	C (M)	2 (A + B) − C
(3)	A	A	0.
	[×]	A	0.
	B	B	0.
	[M+]	A·B (M)	A·B
	C	C (M)	A·B
	[×]	C (M)	A·B
	D	D (M)	A·B
	[M−]	C·D (M)	A·B − C·D
	[M^R_C]	A·B − C·D (M)	A·B − C·D
	[M−]	A·B − C·D	0.
(4)	A	A	0.
	[×]	A	0.
	B	B	0.
	[=]	A·B	0.
	C	C	0.
	[M+]	C (M)	C
	[=]	A·C (M)	C
	D	D (M)	C
	[M−]	D (M)	C − D
	[=]	A·D (M)	C − D
(5)	A	A	0.
	[M+]	A (M)	A
	B	B (M)	A

	Key Op.	Display	Memory
	[M+]	B (M)	A + B
	[MRC]	A + B (M)	A + B
	[×]	A + B (M)	A + B
	[MRC]	A + B (M)	A + B
	[+]	$(A + B)^2$ (M)	A + B
	C	C (M)	A + B
	[=]	$(A + B)^2 + C$ (M)	A + B
(6)	1.0000001	1.0000001	0.
	[M+]	1.0000001 (M)	1.0000001
	99999999	99999999. (M)	1.0000001
	[M+]	0. ($_{E}^{M}$)	1.0000001
	[ON / C / CE]	0. (M)	1.0000001
	[MRC]	1.0000001 (M)	1.0000001

10. Square root

(1)	A	A
	[√]	$\sqrt{A}$
	B	B
(2)	A	A
	[×]	A
	B	B
	[√]	$\sqrt{B}$
	[=]	$A\sqrt{B}$
(3)	A	A
	[×]	A
	[√]	$\sqrt{A}$
	B	B
	[=]	A·B
(4)	[−]	0.
	A	A

	Key Op.	Display	Memory
	[=]	– A	
	[√]	√A (E)	
(5)	A	A	0.
	[M+]	A (M)	A
	[MRC]	A (M)	A
	[÷]	A (M)	A
	B	B (M)	A
	[+/–]	– B (M)	A
	[√]	√B (ME)	A
	[ON/C/CE]	0. (M)	A

11. Percentage calculation

(1)	A	A
	[×]	A
	B	B
	[%]	A·B / 100
	C	C
	[%]	A·C / 100
	D	D
	[%]	A·D / 100
(2)	A	A
	[%]	A
	B	B
	[%]	B
	C	C
	[%]	C
(3)	A	A
	[–]	A
	B	B
	[%]	A – A·B / 100

		Key Op.	Display	Memory
		[−]	$A - A \cdot B / 100$	
		[+]	$A - A \cdot B / 100$	
		C	C	
		[%]	$\left(A - \frac{A \cdot B}{100}\right) + \frac{\left(A - \frac{A \cdot B}{100}\right) \cdot C}{100}$	

12. Key correction

(1)	A	A	0.
	[×]	A	0.
	[÷]	A	0.
	[−]	A	0.
	[+]	A	0.
	[√]	$\sqrt{A}$	0.
	[M+]	$A + \sqrt{A}$ (M)	$A + \sqrt{A}$
	[+/−]	$-(A + \sqrt{A})$ (M)	$A + \sqrt{A}$
	[MRC]	$A + \sqrt{A}$ (M)	$A + \sqrt{A}$
	[MRC]	$A + \sqrt{A}$ (M)	0.
	B	B	0.
	[+]	B	0.
	[−]	B	0.
	[×]	B	0.
	[÷]	B	0.
	[=]	1 / B	0.

13. Others

(1)	A	A	
	[+]	A	
	[=]	A	
(2)	A	A	
	[×]	A	
	[÷]	A	
	[=]	1 / A	

	Key Op.	Display	Memory
(3)	A	A	
	÷	A	
	+	A	
	=	A	
(4)	A	A	
	×	A	
	−	A	
	=	− A	
(5)	A	A	
	÷	A	
	−	A	
	=	− A	
(6)	A	A	
	×	A	
	ON / C / CE	0.	
	B	B	
	=	B	
(7)	A	A	
	×	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

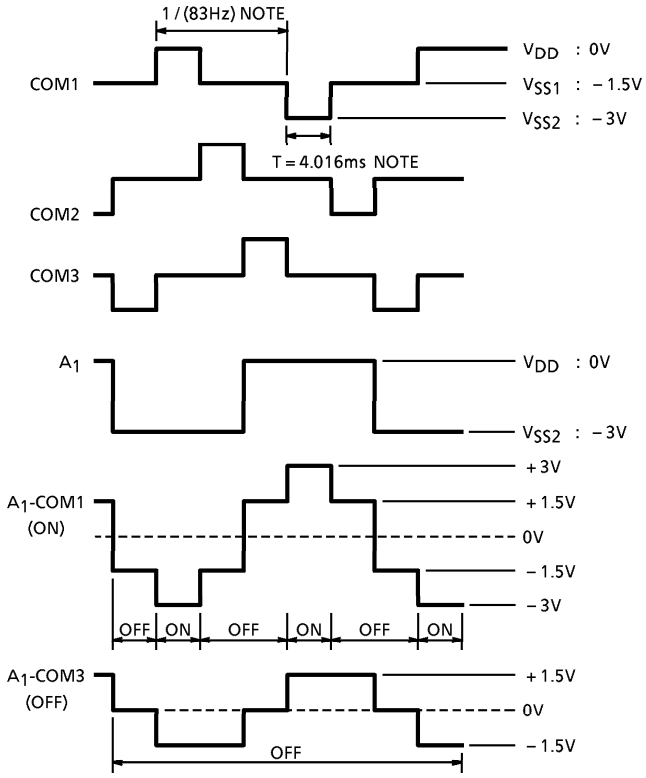
MAXIMUM CHARACTERISTICS

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} = −1.5V±0.2V, V_{SS2} = −3.0V±4.0V, V_{DD} = 0V, Ta = 25°C)

CHARACTERISTICS		SYMBOL	TEST CIR-CUIT	PIN NAME	TEST CONDITION	MIN	TYP.	MAX	UNIT
Operating Voltage		V_{SS1}	—	—	—	−1.2	−1.5	−2.0	V
VOLTAGE	Input "1"	V_{IH}	—	K_2~K_8, RESET	—	V_{SS1} +0.4	—	V_{SS1}	V
	Input "0"	V_{IL}	—	K2~K_8, RESET	—	0	—	−0.4	V
	Output "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}	—	K_1~K_8, RESET	—	V_{SS1} +0.2	—	V_{SS1}	V
	Output "0"	V_{OL}	—	K_1~K_6, RESET	—	0	—	−0.2	V
Resistance	Output "1"	R_{OH}	—	Segment	V_{OUT} = V_{DD2} +0.5V	—	—	70	kΩ
	Output "0"	R_{OL}	—	Segment	V_{OUT} = −0.5V	—	—	70	kΩ
	Output "1"	R_{OH}	—	Common	V_{OUT} = V_{DD2} +0.5V	—	—	70	kΩ
	Output "0"	R_{OL}	—	Common	V_{OUT} = −0.5V	—	—	70	kΩ
	Pull Up	R_{KH}	—	K_1~K_8	V_{OUT} = 0V	60	400	1500	kΩ
		RESET	—	RESET	V_{OUT} = 0V	200	300	400	
	Output "0"	R_{OL}	—	K_1~K_6	V_{OUT} = −0.5V	—	—	10	kΩ
Supply Current 1 (On Display)		I_{DD1}	—	—	V_{SS1} = −1.5V (No Keys)	—	−2.2	−3.6	μA
Supply Current 2 (Operation)		I_{DD2}	—	—	V_{SS1} = −1.2V (Peak OF A11 9√‾)	—	−4.4	−6.6	μA
Supply Current 3 (Off)		I_{DD3}	—	—	V_{SS1} = −1.5V (Off Status)	—	−0.5	−2.0	μA
Oscillating Frequency		fosc (WAIT)	—	—	V_{SS1} = −1.5V On Display	5.4	9	12.6	kHz
		fosc (OP)			V_{SS1} = −1.5V On Operating	10.8	18	25.2	
Frame Frequency		f_F	—	—	V_{SS1} = −1.5V (Wait)	50	83	117	Hz
Power off Timer		T timer	—	—	V_{SS1} = −1.5V	252	420	588	s

WAVEFORMS FOR DISPLAY



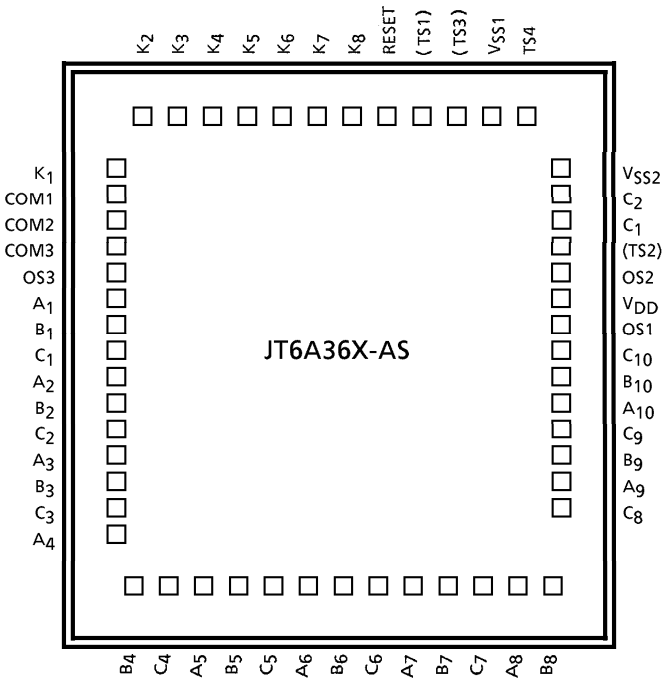
NOTE : f_ϕ = 9kHz

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

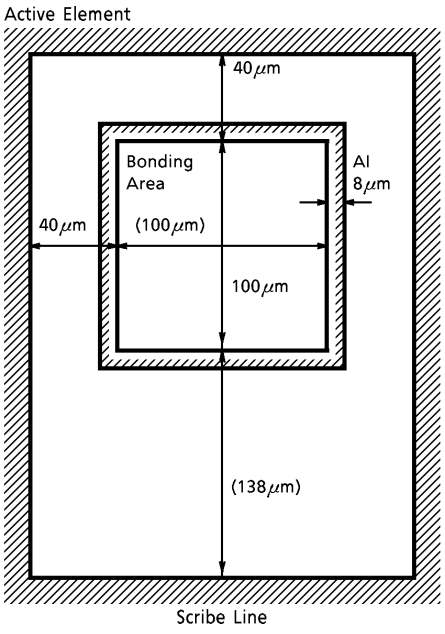
NAME	X POINT	Y POINT
B_4	– 1097	– 1412
C_4	– 946	– 1412
A_5	– 794	– 1412
B_5	– 642	– 1412
C_5	– 491	– 1412
A_6	– 339	– 1412
B_6	– 187	– 1412
C_6	– 36	– 1412
A_7	116	– 1412
B_7	268	– 1412
C_7	420	– 1412
A_8	571	– 1412
B_8	723	– 1412
C_8	1084	– 1240
A_9	1084	– 1088
B_9	1084	– 936
C_9	1084	– 785
A_{10}	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}

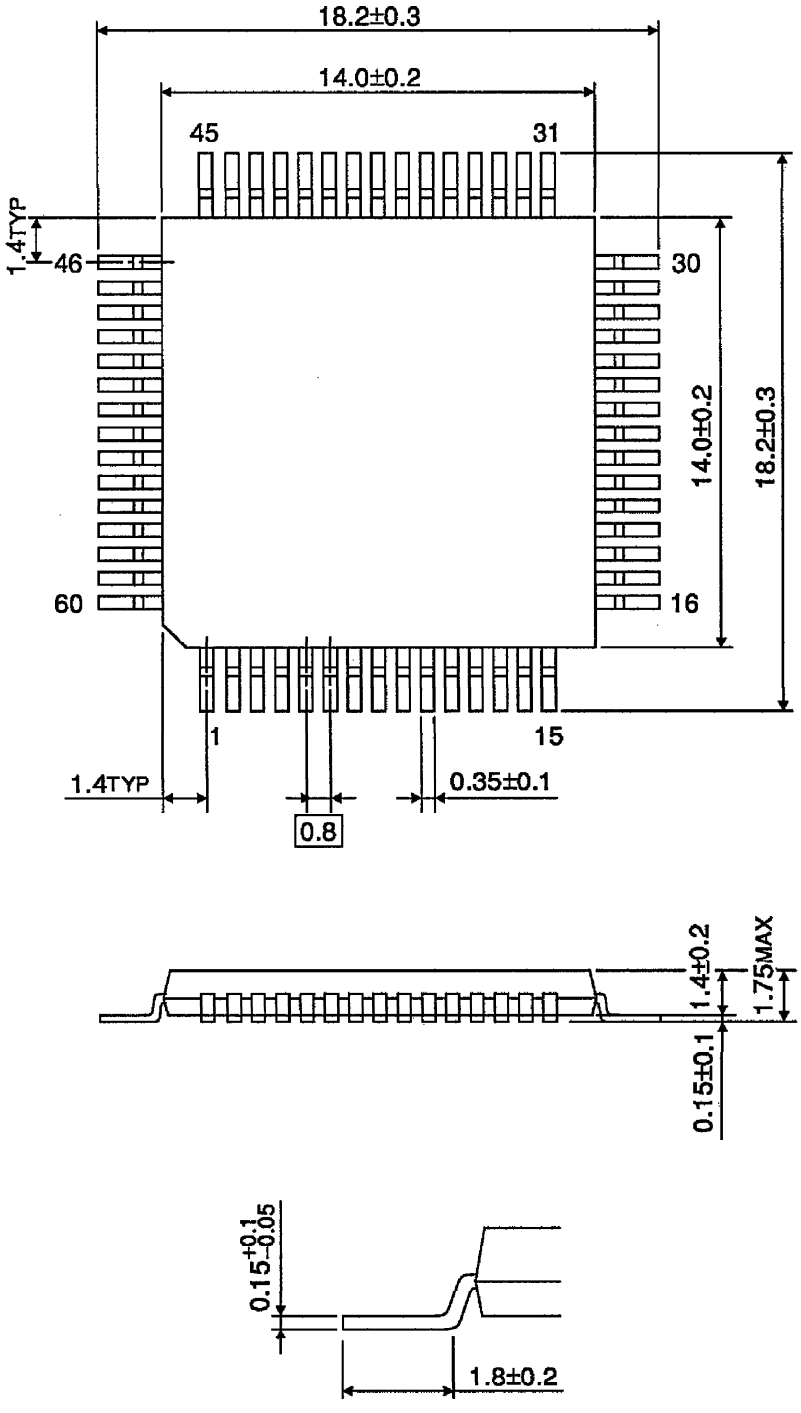
PAD LAYOUT



PAD Pitch 151μm

PACKAGE DIMENSIONS

LQFP60-P-1414-0.80 Unit : mm



Weight : 0.66g (Typ.)