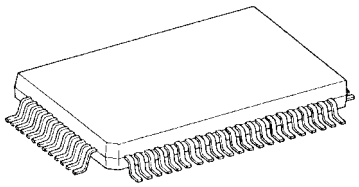
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

T6M19,JT6M19-AS

T6M19, JT6M19-AS Single-Chip CMOS LSI for LCD Calculators

The T6M19, JT6M19-AS is single-chip microcomputer for 10-digit + 2-digit scientific calculation.

T6M19, JT6M19-AS is the complete single-chip CMOS LSI for calculator with 10 digits, 67 functions, 3 expression and hexadecimal, octal and binary, statistic calculation, fractional number calculation, and logic operation with the following features.



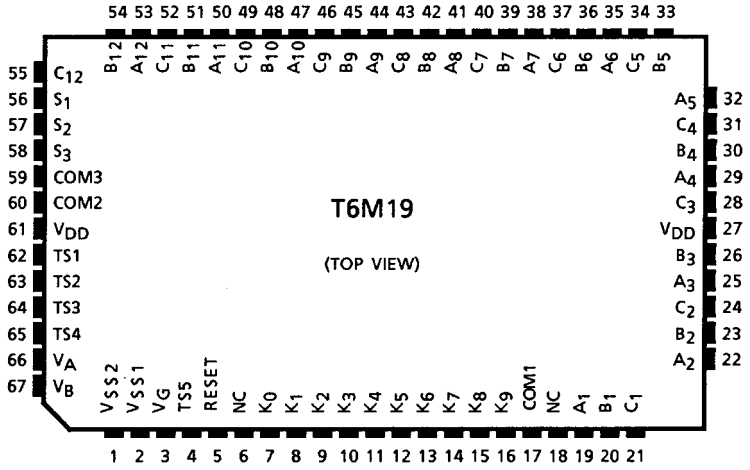
QFP67-P-1420-0.80

Weight: 1.20 g (typ.)

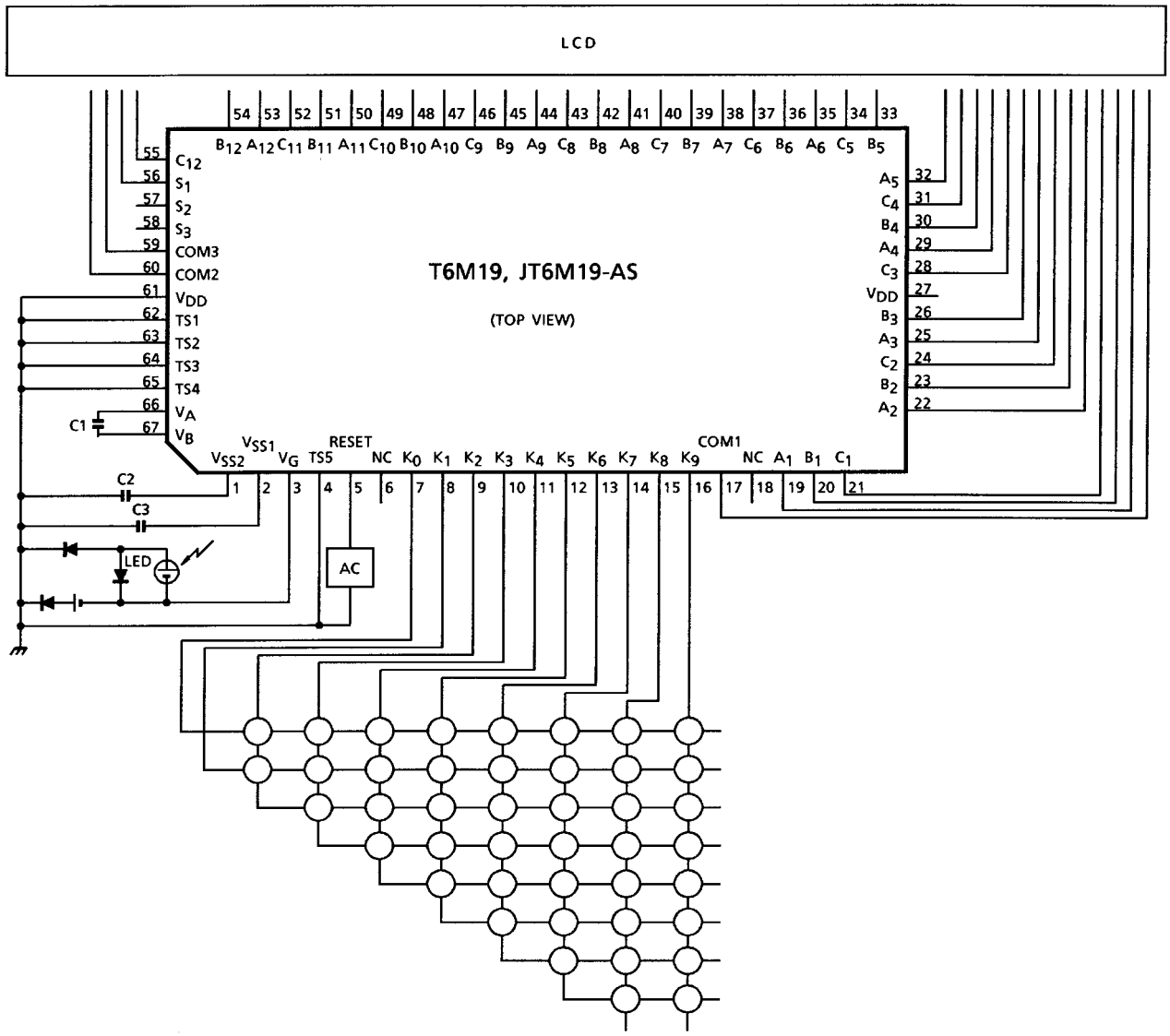
Features

- 12-digit display plus 2-digit code at the right margin.
  - Scientific and engineering display.
    Mantissa 10 digits plus exponent 2 digits plus negative code 2 digits.
  - Other than above
    Mantissa 10 digits plus negative code 1 digit.
- 13 kinds of special display
  - M: Memory
    —: Mantissa and exponent minus
    E: Error
    INV: Inverse
    HYP: Hyperbolic
    BIN: Binary mode
    OCT: Octal mode
    HEX: Hexadecimal mode
    SD: Statistic calculation mode
    DEG: Degree
    RAD: Radian
    GRAD: Gradian
    ( ): Parenthesis calculation
- The minus sign of the mantissa is floating minus.
- The arithmetic key operation in clouding Y^x or $Y^{1/x}$ has same sequence as mathematical equation. 6 pending operations are allowed and ( ) are up to continuous 15 levels.
- Fractional number calculation.
- It is possible to convert mutually between decimal, binary, octal and hexadecimal, and the 4 operations in arithmetic in binary, octal and hexadecimal.
- One independent accumulating memory.
- It is possible to convert or fix the display number system by FLO (floating), SCI (scientific) or ENG (engineering) key.
- It is possible to specify decimal part digits (0~9) by FIX key.
- Direct drive for FEM LCD (1/2 prebias, 1/3 duty).
- Automatic power on clear.
- Low-power consumption. $V_G = -1.5$ V single power supply.
- The 67-pin flat package is used.
- Automatic power off (a time for about 10 min).

Pin Assignment (top view)



System Block Diagram



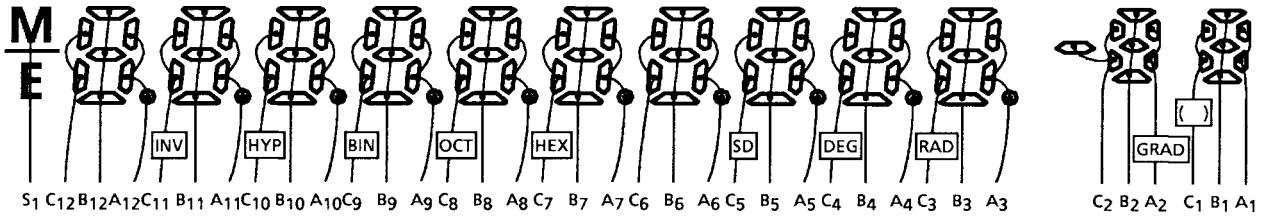
C1 = C2 = 0.1 μF

C3 = 10 μF

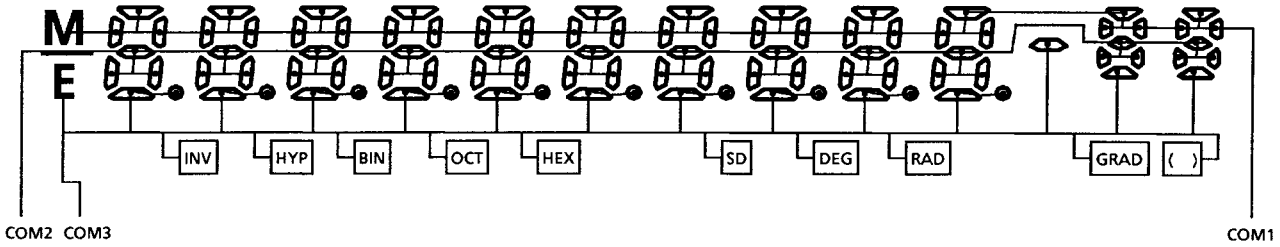
Note 1: Key resistance ≦ 5.0 kΩ at V_G = −1.2 V

Connection of LCD

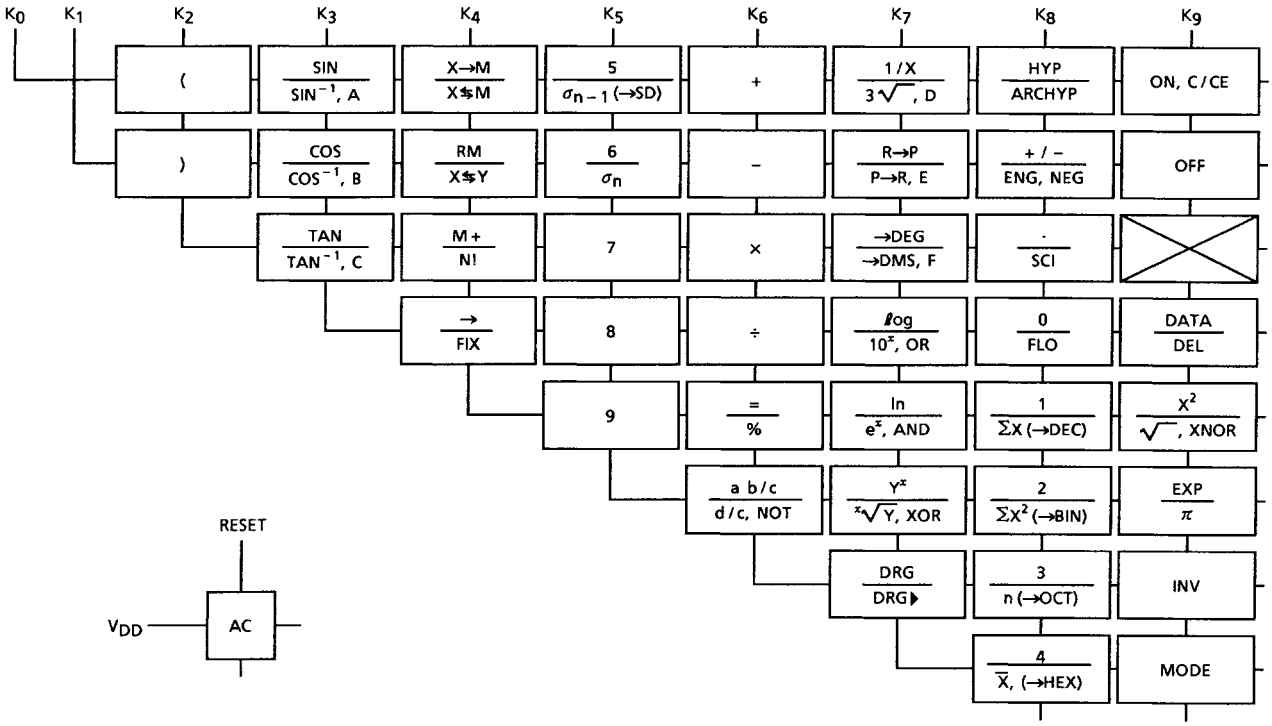
Segment



Common



Key Connection



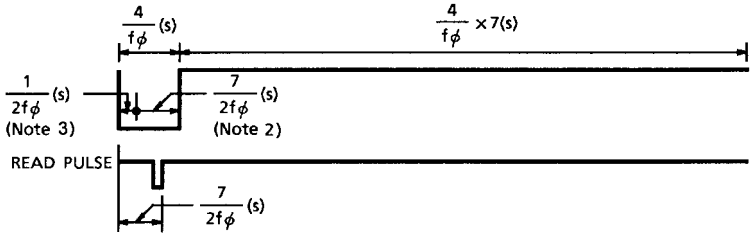
Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_G	+0.3~−2.2	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

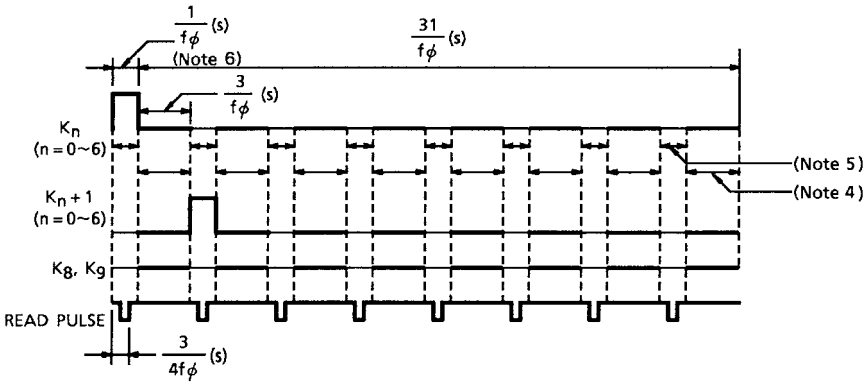
Electrical Characteristics (V_G = –1.5 V ± 0.2 V, V_{SS2} = –3.0 ± 0.4 V, V_{DD} = 0 V, Ta = 25°C)

Characteristics	Symbol	Test Circuit	Pin Name	Test Condition	Min	Typ.	Max	Unit
Operating voltage	V_G	—	—	—	−1.2	−1.5	−2.0	V
Supply current (I)	I_{DD} WAIT	—	—	V_G = −1.5 V, wait	—	2.0	3.0	μA
Supply current (II)	I_{DD} OP	—	—	V_G = −1.2 V, operate	—	4.5	7.0	μA
Supply current (III)	I_{DD} OFF	—	—	V_G = −1.5 V, off	—	—	2.0	μA
Oscillating frequency (I)	f_ϕ WAIT	—	—	V_G = −1.5 V, wait	5.4	9.0	12.6	kHz
Oscillating frequency (II)	f_ϕ OP	—	—	V_G = −1.5 V, operate	14.4	24.0	33.6	kHz
Frame frequency	f_F	—	—	V_G = −1.5 V, wait	56.3	93.8	131.3	Hz
"1" input voltage	V_{IH}	—	K_2~K_9 RESET	—	V_G + 0.4	—	V_G	V
"0" input voltage	V_{IL}	—	K_2~K_9 RESET	—	V_{SS}	—	−0.4	V
"1" output voltage	V_{OH} (I)	—	SEGMENT COM1~3	—	V_{SS2} + 0.2	—	V_{SS2}	V
"0" output voltage	V_{OL} (I)	—	SEGMENT COM1~3	—	V_{DD}	—	−0.2	V
"M" output voltage	V_{OH}	—	COM1~3	—	V_{SS1} + 0.2	—	V_{SS1} − 0.2	V
"1" output voltage	V_{OH} (II)	—	K_0~K_9 RESET	—	V_{SS1} + 0.2	—	V_{SS1}	V
"0" output voltage	V_{OL} (II)	—	K_0~K_9 RESET	—	V_{DD}	—	−0.2	V
"1" output resistance	R_{OH}	—	SEGMENT COM1~3	V_{OUT} = V_{SS2} + 0.5 V	—	—	70	kΩ
"0" output resistance	R_{OL}	—	SEGMENT COM1~3	V_{OUT} = −0.5 V	—	—	70	kΩ
RESET pull up resistance (I)	$R_{RESETH\ (I)}$	—	RESET	V_{OUT} = 0 V (Note 2)	156	260	364	kΩ
RESET pull up resistance (II)	$R_{RESETH\ (II)}$	—	RESET	V_{OUT} = 0 V (Note 3)	18	75	300	kΩ
Key pull up resistance (I)	$R_{KEYH\ (I)}$	—	K_0~K_9	V_{OUT} = V_G + 0 5 V (Note 4)	—	—	500	kΩ
Key pull up resistance (II)	R_{KEYH}	—	K_0~K_9	V_{OUT} = 0 V (Note 5)	60	300	1500	kΩ
Key RESET pull down resistance	R_{KEYL} RESETL	—	K_0~K_9 RESET	V_{OUT} = −0.5 V (Note 6)	—	—	25	kΩ

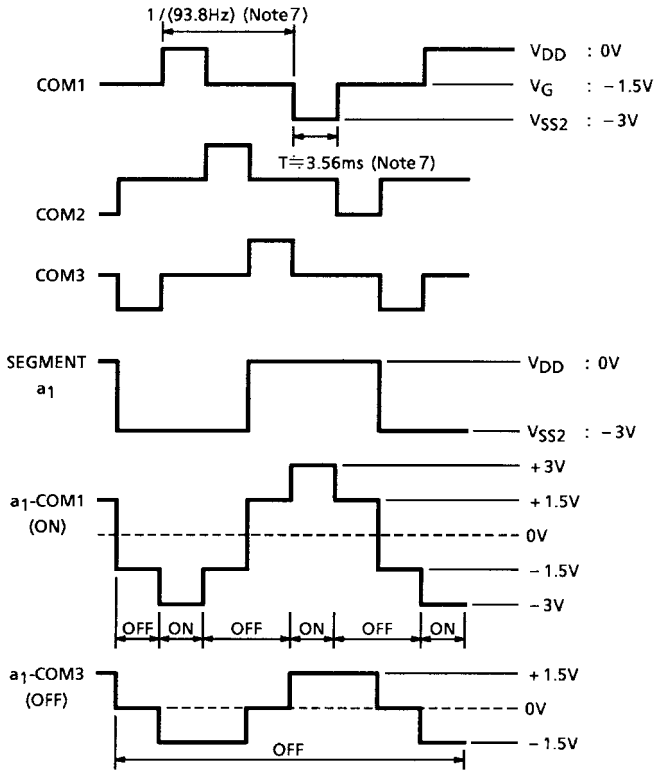
Note 2, 3, 6: RESET waveform, 1-cycle



Note 4, 5, 6: KEY waveform, 1-cycle



Waveforms for Display



Note 7: f_ϕ WAIT = 9 kHz

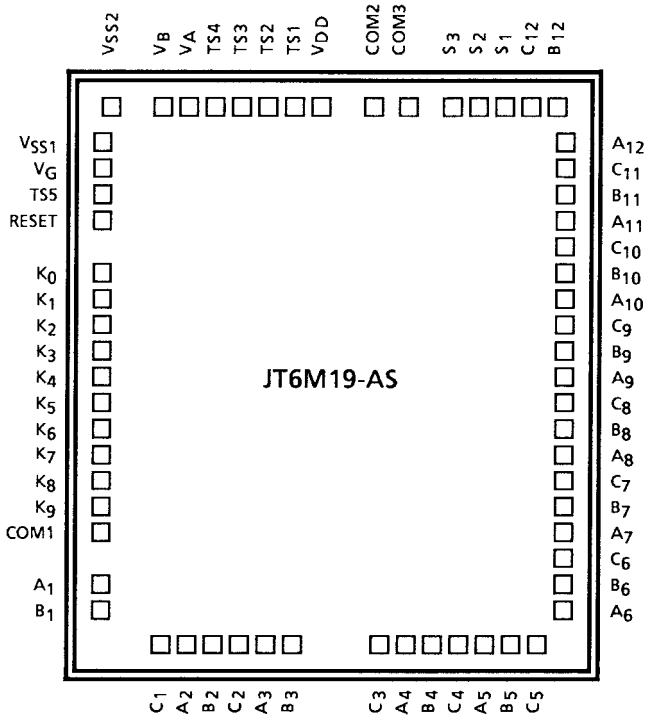
Pad Location Table

(μm)

Name	X Point	Y Point
V_{SS2}	−1783	2330
V_{SS1}	−1894	2102
V_G	−1894	1901
TS5	−1894	1690
RESET	−1894	1469
K_0	−1894	1070
K_1	−1894	789
K_2	−1894	547
K_3	−1894	265
K_4	−1894	23
K_5	−1894	−259
K_6	−1894	−501
K_7	−1894	−782
K_8	−1894	−1024
K_9	−1894	−1306
COM1	−1894	−1602
A_1	−1894	−2023
B_1	−1894	−2258
C_1	−1513	−2330
A_2	−1277	−2330
B_2	−1042	−2330
C_2	−806	−2330
A_3	−571	−2330
B_3	−336	−2330
C_3	118	−2330
A_4	353	−2330
B_4	589	−2330
C_4	824	−2330
A_5	1059	−2330
B_5	1295	−2330
C_5	1530	−2330
A_6	1894	−2234

Name	X Point	Y Point
B_6	1894	−1937
C_6	1894	−1709
A_7	1894	−1482
B_7	1894	−1254
C_7	1894	−1026
A_8	1894	−799
B_8	1894	−571
C_8	1894	−343
A_9	1894	−116
B_9	1894	112
C_9	1894	332
A_{10}	1894	557
B_{10}	1894	784
C_{10}	1894	1012
A_{11}	1894	1240
B_{11}	1894	1467
C_{11}	1894	1695
A_{12}	1894	1920
B_{12}	1839	2330
C_{12}	1606	2330
S_1	1373	2330
S_2	1140	2330
S_3	902	2330
COM3	565	2330
COM2	295	2330
V_{DD}	−51	2330
TS1	−263	2330
TS2	−484	2330
TS3	−681	2330
TS4	−888	2330
V_A	−1124	2330
V_B	−1371	2330

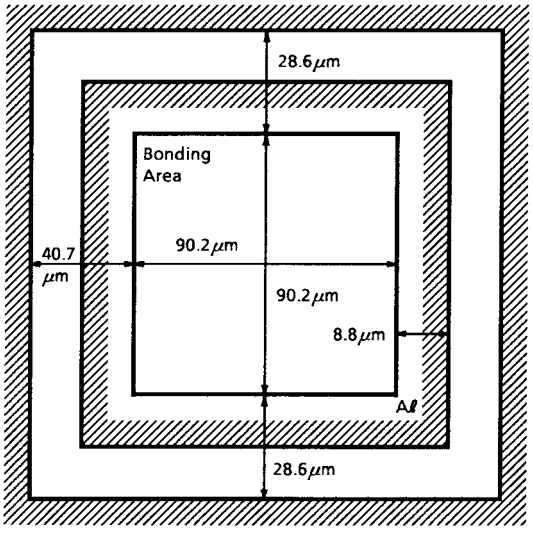
Chip Layout



Chip size : 4.04 × 4.98 (mm)
Chip thickness : 450 ± 20 μm
Substrate : V_{DD}

Pad Layout

Active Element

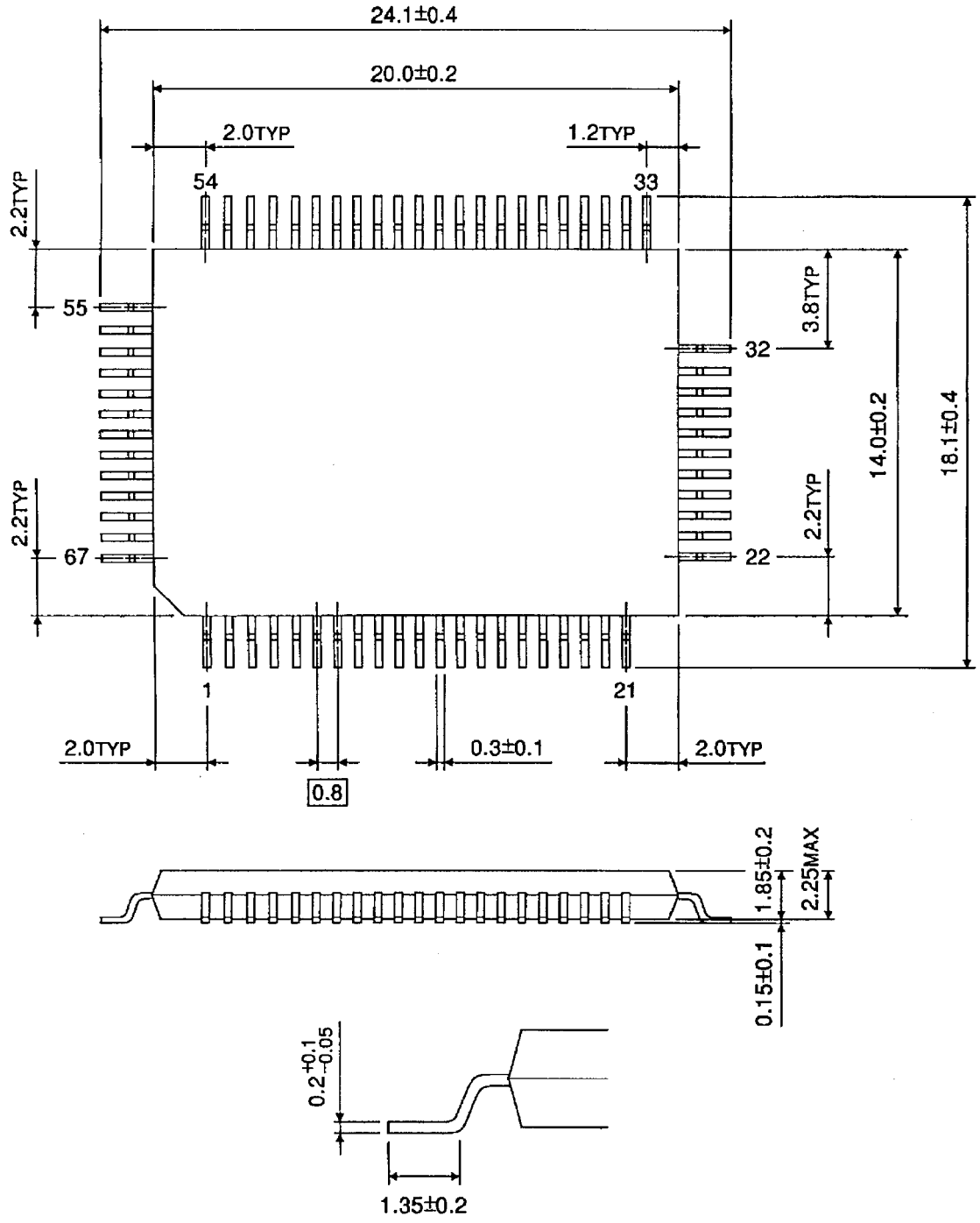


Scribe Line

PAD Pitch 201.3μm

Package Dimensions

QFP67-P-1420-0.80 Unit : mm



Weight: 1.20 g (typ.)

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