

# JT6A72-CS

## JT6A72-CS CMOS SINGLE-CHIP LSI FOR LCD CALCULATOR

The JT6A72-CS is a single-chip microcomputer for 8-digit 1-memory calculator. JT6A72-CS can drive the liquid crystal display (LCD). Single power supply operation, low-power consumption make it suitable for single battery operated pocketable calculator.

### FEATURES

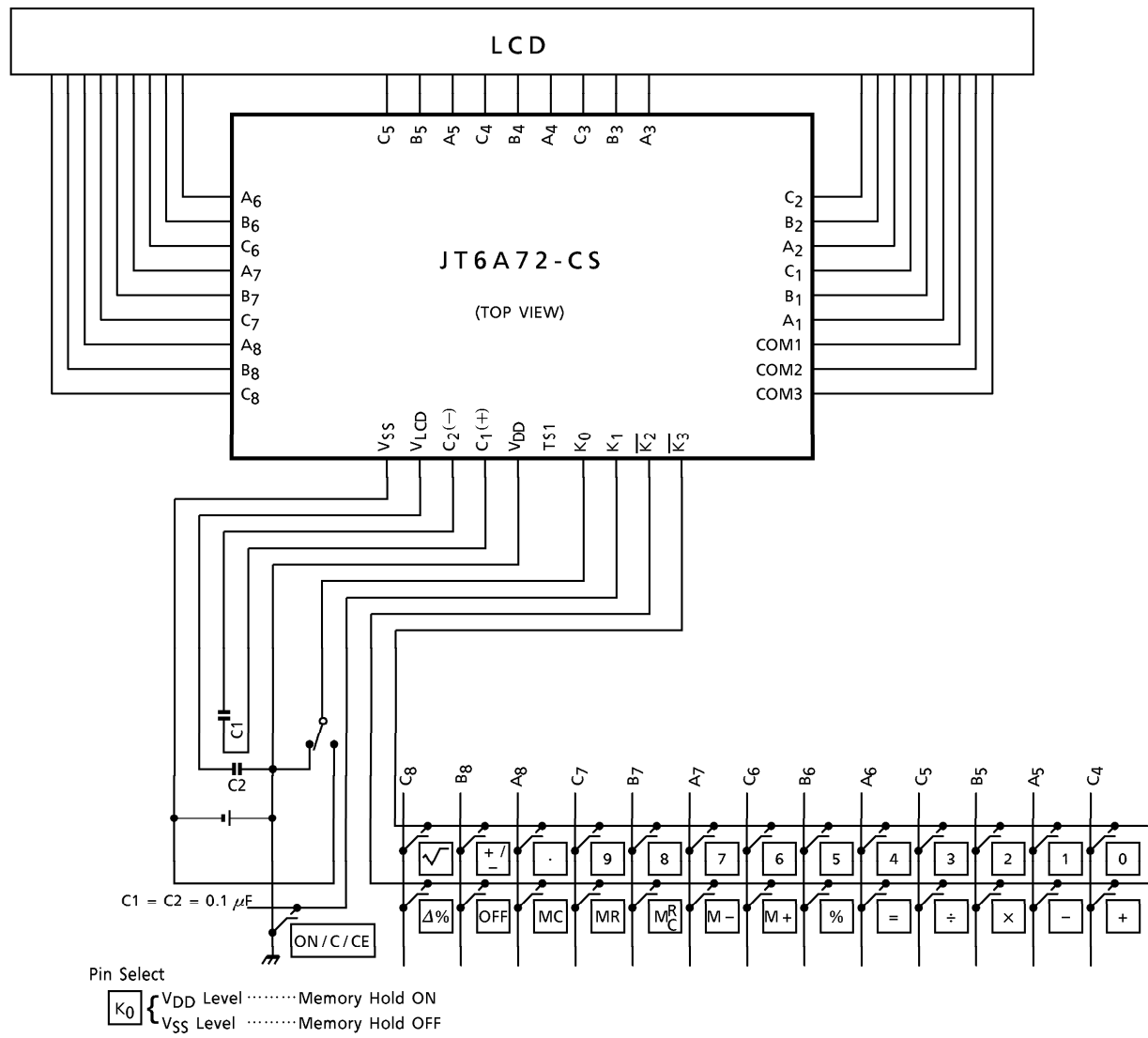
- 8 digits of data and 1 symbol digit for calculator.
- Algebraic calculation mode.
- Punctuation.
- Standard 4 functions (+, -, ×, ÷), mark up percent with automatic add-on/discount, automatic constant calculations, chain calculations, memory calculations with memory overflow protection.
- Internal 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 (1.4 V typ.).
- Very low power consumption (2.66  $\mu$ W typ. at wait).
- Very wide range of operating voltage ( $V_{DD}$  = 1.1~1.9 V).
- Automatic power off (A time for about 7 min.).

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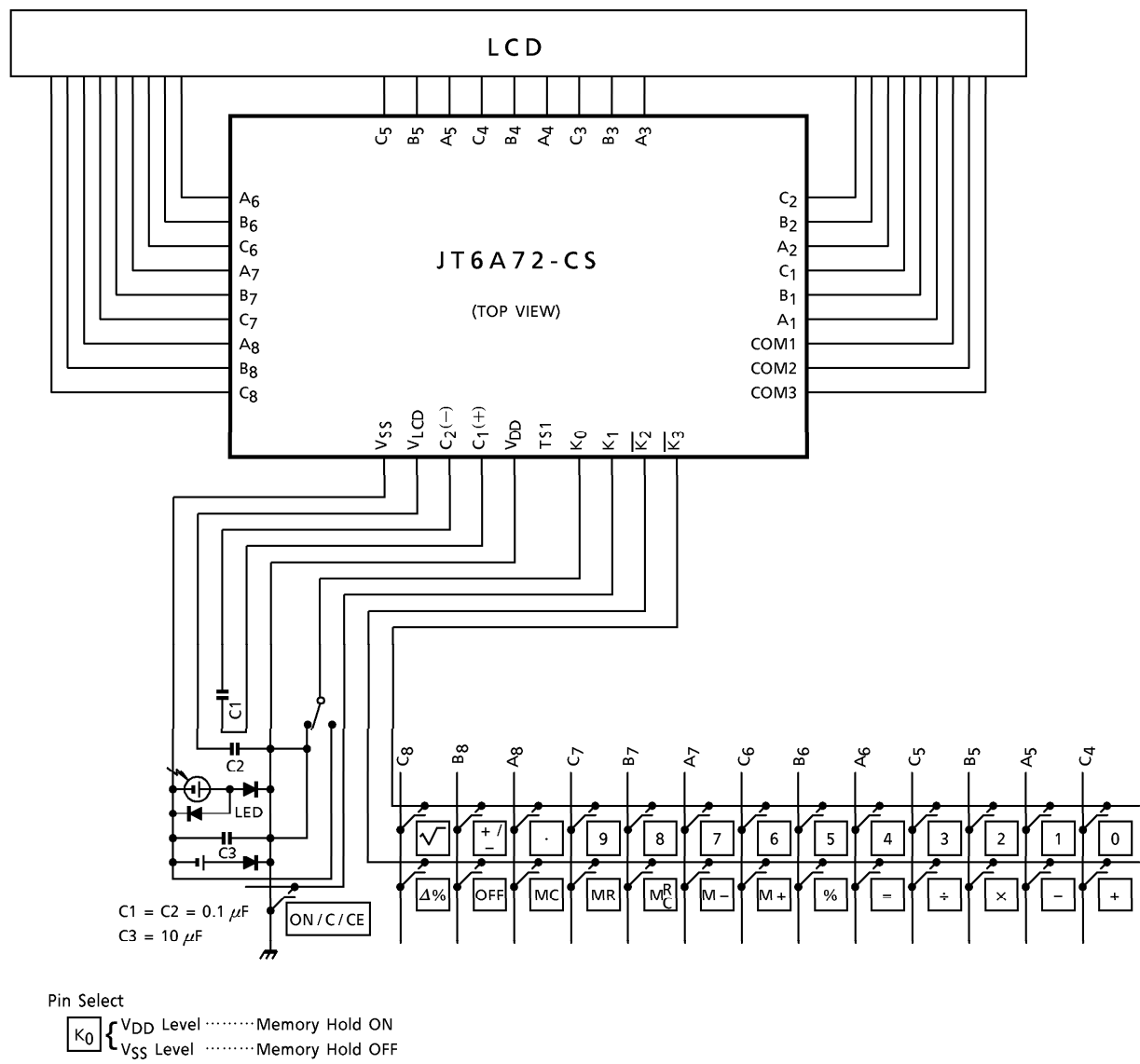
SYSTEM BLOCK DIAGRAM

Battery Type



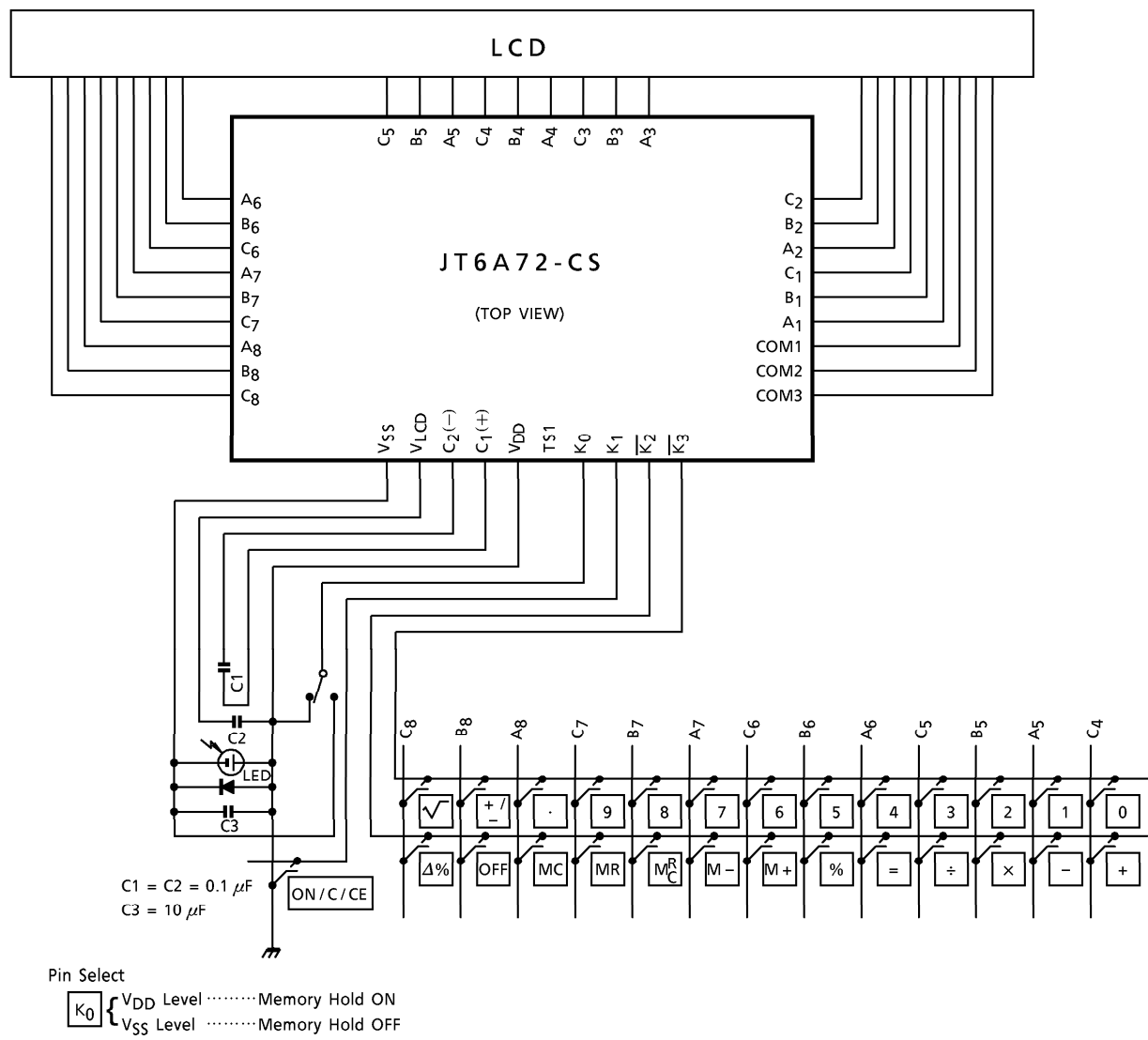
(Note) : INPUT capacity  $\leq 400$  (pF) at  $V_{DD} = 1.4$  (V)  
Key resistance  $\leq 10$  (k $\Omega$ ) at  $V_{DD} = 1.4$  (V)

Dual Type



(Note) : INPUT capacity  $\leq 400$  (pF) at  $V_{DD} = 1.4$  (V)  
Key resistance  $\leq 10$  (k $\Omega$ ) at  $V_{DD} = 1.4$  (V)

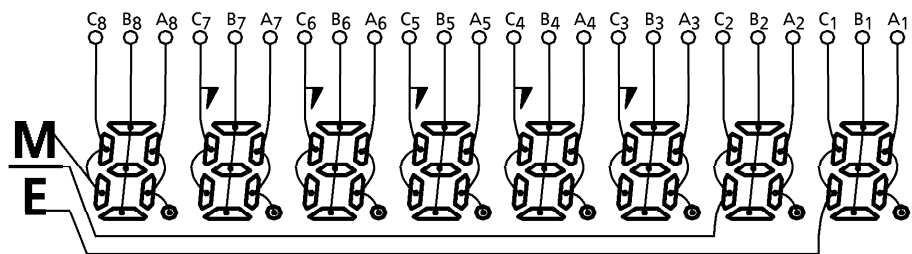
Solar Type



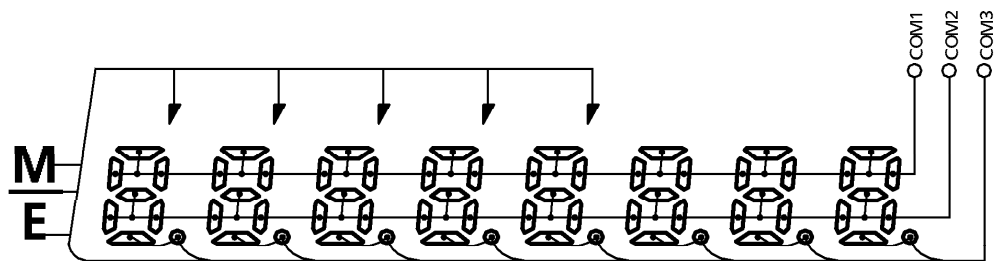
(Note) : INPUT capacity  $\leq$  400 (pF) at  $V_{DD}$  = 1.4 (V)  
Key resistance  $\leq$  10 (k $\Omega$ ) at  $V_{DD}$  = 1.4 (V)

CONNECTION OF LCD

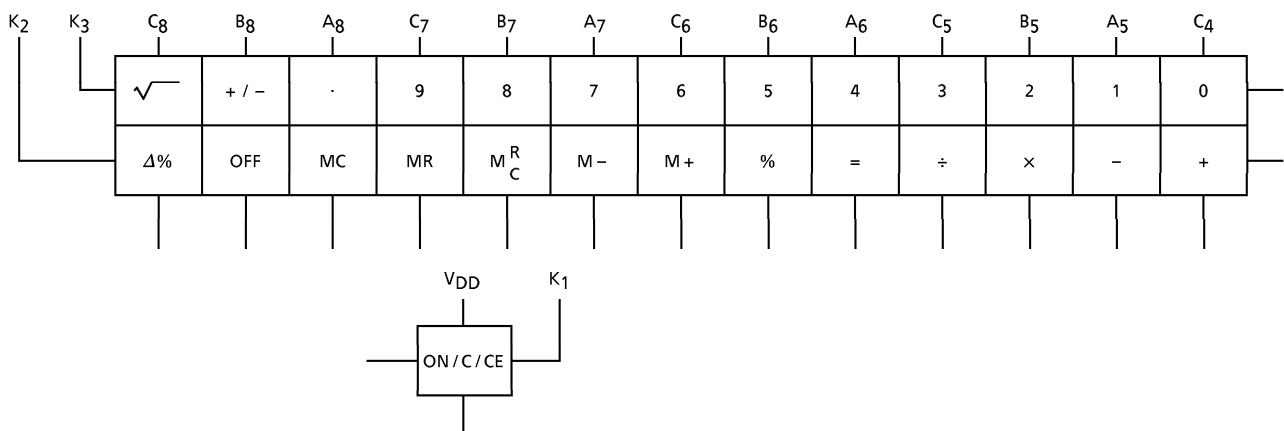
SEGMENT



COMMON



KEY CONNECTION



**SPECIFICATION OF CALCULATOR**

## Operational Features

- (1) 8 digits of data and 1 symbol digit.
- (2) Algebraic mode.
- (3) Full floating point.
- (4) Standard 4 functions  $+$ ,  $-$ ,  $\times$ ,  $\div$ .
- (5) Memory calculation and memory hold.
- (6) Delta Percent, mark-up and mark-down functions.
- (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

The display font shows the memory indicator 'M' over 'E' on the left, followed by digits 1 through 9, and a decimal point. Each digit has a small apostrophe-like mark above it, likely indicating a specific font style or a placeholder for a sign.

## Overflow Condition

- (1) When division by zero is attempted, an overflow condition will result, and error symbol "E" and a zero are displayed.
- (2) When the integer part of result exceeds 8 digits, the display will shown 8 most significant digits of result divided by  $10^{+8}$  and "E".
- (3) When the integer part of result exceeds 15 digits, display will show a zero and "E".
- (4) When the integer part of result in memory register exceeds 8 digits at memory calculation, display will show a zero and "E", and previous data will be kept in memory register.
- (5) When an overflow occurs on the way of add-on / discount calculation, display will show a zero and "E".
- (6) In overflow condition, any operation or numeral entry will be inhibited.

## Clearing Overflow Condition

- (1) The resulting overflow condition can be cleared by depressing **ON/C/CE** .
- (2) At memory overflow condition, depression of **MR** or **M<sub>R</sub><sup>R</sup><sub>C</sub>** after **ON/C/CE** will recall the previous memory data.
- (3) At the condition of exceeding capacity overflow occurred in chain calculation, depression of **ON/C/CE** will reset the error symbol "E", and you can continue the calculation using the displayed data.

Speed of Calculation

|     |                        |          |                  |          |                                             |
|-----|------------------------|----------|------------------|----------|---------------------------------------------|
| (1) | Numeral entry          |          |                  |          | 56.0~59.3 ms                                |
| (2) | Addition               | 11111111 | $\boxed{+}$      | 11111111 | $\boxed{=}$ 102.6~105.9 ms                  |
| (3) | Multiplication         | 1        | $\boxed{\times}$ | 99999999 | $\boxed{=}$ 258.6~261.9 ms                  |
| (4) | Division               | 99999999 | $\boxed{\div}$   | 1        | $\boxed{=}$ 294.6~297.9 ms                  |
| (5) | Memory Calculation     | 99999999 | $\boxed{\div}$   | 1        | $\boxed{M+}$ 345.3~348.6 ms                 |
| (6) | Percentage calculation | 1        | $\boxed{+}$      | 99999999 | $\boxed{\%}$ 287.9~291.2 ms                 |
| (7) | Square root            |          |                  | 99999999 | $\boxed{\sqrt{\phantom{x}}}$ 259.9~263.2 ms |

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

|     |             |           |
|-----|-------------|-----------|
| (1) | A           | A         |
|     | $\boxed{-}$ | A         |
|     | B           | B         |
|     | $\boxed{-}$ | A - B     |
|     | C           | C         |
|     | $\boxed{=}$ | A - B - C |
|     | $\boxed{-}$ | A - B - C |
|     | D           | D         |

|  | Key Op.          | Display           |
|--|------------------|-------------------|
|  | <div>+ / -</div> | - D               |
|  | <div>-</div>     | A - B - C + D     |
|  | <div>=</div>     | - (A - B - C + D) |

3. Multiplication

|     |              |         |
|-----|--------------|---------|
| (1) | A            | A       |
|     | <div>×</div> | A       |
|     | B            | B       |
|     | <div>=</div> | A·B     |
|     | <div>+</div> | A·B     |
|     | C            | C       |
|     | <div>=</div> | A·B + C |
| (2) | <div>-</div> | 0.      |
|     | A            | A       |
|     | <div>×</div> | - A     |
|     | B            | B       |
|     | <div>=</div> | - A·B   |

4. Division

|     |              |         |
|-----|--------------|---------|
| (1) | A            | A       |
|     | <div>÷</div> | A       |
|     | B            | B       |
|     | <div>=</div> | A / B   |
| (2) | <div>-</div> | 0.      |
|     | A            | A.      |
|     | <div>÷</div> | - A     |
|     | B            | B       |
|     | <div>=</div> | - A / B |

5. Power calculation

|     |              |   |
|-----|--------------|---|
| (1) | A            | A |
|     | <div>×</div> | A |

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

6. Mixed calculation

|     |                  |                 |
|-----|------------------|-----------------|
| (1) | A                | A               |
|     | $\boxed{\times}$ | A               |
|     | B                | B               |
|     | $\boxed{+}$      | $A \cdot B$     |
|     | C                | C               |
|     | $\boxed{\div}$   | $A \cdot B + C$ |
|     | D                | D               |

7. Constant calculation

|     | Key Op.      | Display                       |
|-----|--------------|-------------------------------|
|     | <div>-</div> | $\frac{A \cdot B + C}{D}$     |
|     | E            | E                             |
|     | <div>=</div> | $\frac{A \cdot B + C}{D} - E$ |
| (1) | A            | A                             |
|     | <div>×</div> | A                             |
|     | B            | B                             |
|     | <div>=</div> | A · B                         |
|     | C            | C                             |
|     | <div>=</div> | A · C                         |
| (2) | <div>-</div> | 0.                            |
|     | A            | A                             |
|     | <div>×</div> | - A                           |
|     | B            | B                             |
|     | <div>=</div> | - A · B                       |
|     | C            | C                             |
|     | <div>=</div> | - A · C                       |
| (3) | A            | A                             |
|     | <div>÷</div> | A                             |
|     | B            | B                             |
|     | <div>=</div> | A / B                         |
|     | C            | C                             |
|     | <div>=</div> | C / B                         |
|     | D            | D                             |
|     | <div>×</div> | D                             |
|     | <div>=</div> | D <sup>2</sup>                |
| (4) | A            | A                             |
|     | <div>+</div> | A                             |
|     | B            | B                             |

|     | Key Op.      | Display |
|-----|--------------|---------|
| (5) | <div>=</div> | A + B   |
|     | C            | C       |
|     | <div>=</div> | C + B   |
|     | A            | A       |
|     | <div>-</div> | A       |
|     | B            | B       |
|     | <div>=</div> | A - B   |
|     | C            | C       |
|     | <div>=</div> | C - B   |
|     | A            | A       |
| (6) | <div>×</div> | A       |
|     | B            | B       |
|     | <div>=</div> | A·B     |
|     | C            | C       |
|     | <div>×</div> | C       |
|     | D            | D       |
|     | <div>=</div> | C·D     |
|     | E            | E       |
|     | <div>=</div> | C·E     |
|     | <div>×</div> | C·E     |
|     | F            | F       |
|     | <div>=</div> | C·E·F   |
|     | G            | G       |
|     | <div>÷</div> | G       |
|     | H            | H       |
|     | <div>=</div> | G / H   |
|     | I            | I       |
|     | <div>=</div> | I / H   |

|     | Key Op.      | Display           |
|-----|--------------|-------------------|
| (7) | A            | A                 |
|     | <div>×</div> | A                 |
|     | B            | B                 |
|     | <div>%</div> | $A \cdot B / 100$ |
|     | C            | C                 |
|     | <div>%</div> | $A \cdot C / 100$ |
|     | D            | D                 |
|     | <div>÷</div> | D                 |
|     | E            | E                 |
|     | <div>%</div> | $100 \cdot D / E$ |
|     | F            | F                 |
|     | <div>%</div> | $100 \cdot F / E$ |

8. Mark-up / Discount calculator

|     |              |                       |
|-----|--------------|-----------------------|
| (1) | A            | A                     |
|     | <div>×</div> | A                     |
|     | B            | B                     |
|     | <div>+</div> | $A \cdot B$           |
|     | <div>=</div> | $A + A \cdot B$       |
| (2) | A            | A                     |
|     | <div>×</div> | A                     |
|     | B            | B                     |
|     | <div>-</div> | $A \cdot B$           |
|     | <div>=</div> | $A - A \cdot B$       |
| (3) | A            | A                     |
|     | <div>×</div> | A                     |
|     | B            | B                     |
|     | <div>%</div> | $A \cdot B / 100$     |
|     | <div>+</div> | $A \cdot B / 100$     |
|     | <div>=</div> | $A + A \cdot B / 100$ |
|     |              |                       |

|     | Key Op.          | Display               |
|-----|------------------|-----------------------|
| (4) | A                | A                     |
|     | $\boxed{\times}$ | A                     |
|     | B                | B                     |
|     | $\boxed{\%}$     | $A \cdot B / 100$     |
|     | $\boxed{-}$      | $A \cdot B / 100$     |
|     | $\boxed{=}$      | $A - A \cdot B / 100$ |
| (5) | A                | A                     |
|     | $\boxed{+}$      | A                     |
|     | B                | B                     |
|     | $\boxed{\%}$     | $A + AB / 100$        |
| (6) | A                | A                     |
|     | $\boxed{-}$      | A                     |
|     | B                | B                     |
|     | $\boxed{\%}$     | $A - AB / 100$        |

9. Memory calculation

|     | Key Op.                         | Display         | Memory      |
|-----|---------------------------------|-----------------|-------------|
|     | 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)           | $A + B - C$ |
|     | $\boxed{M^R_C}$ or $\boxed{MR}$ | $A + B - C (M)$ | $A + B - C$ |
|     | $\boxed{M^R_C}$ or $\boxed{MC}$ | $A + B - C$     | 0.          |
| (2) | A                               | A               | 0.          |
|     | $\boxed{+}$                     | A               | 0.          |
|     | B                               | B               | 0.          |
|     | $\boxed{M+}$                    | $A + B (M)$     | $A + B$     |

|     | Key Op.                         | Display       | Memory        |
|-----|---------------------------------|---------------|---------------|
|     | $\boxed{+}$                     | 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)       | AB - CD       |
|     | $\boxed{M^R_C}$ or $\boxed{MR}$ | A·B - C·D (M) | AB - CD       |
|     | $\boxed{M-}$                    | A·B - C·D     | 0.            |
| (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         |
|     | $\boxed{M^R_C}$ or $\boxed{MR}$ | A + B (M)     | A + B         |

| Key Op. |                 | Display             | Memory    |
|---------|-----------------|---------------------|-----------|
|         | $\times$        | $A + B (M)$         | $A + B$   |
|         | $M_C^R$ or $MR$ | $A + B (M)$         | $A + B$   |
|         | $+$             | $(A + B)^2 (M)$     | $A + B$   |
|         | $C$             | $C (M)$             | $A + B$   |
|         | $=$             | $(A + B)^2 + C (M)$ | $A + B$   |
| (6)     | 1.0000001       | 1.0000001           | 0.        |
|         | $M +$           | 1.0000001 (M)       | 1.0000001 |
|         | 99999999        | 99999999. (M)       | 1.0000001 |
|         | $M +$           | 0. ( $M_E$ )        | 1.0000001 |
|         | $ON / C / CE$   | 0. (M)              | 1.0000001 |
|         | $M_C^R$ or $MR$ | 1.0000001 (M)       | 1.0000001 |

10.Square root

|     |                      |                |
|-----|----------------------|----------------|
| (1) | A                    | A              |
|     | $\sqrt{\phantom{x}}$ | $\sqrt{A}$     |
|     | B                    | B              |
| (2) | A                    | A              |
|     | $\times$             | A              |
|     | B                    | B              |
|     | $\sqrt{\phantom{x}}$ | $\sqrt{B}$     |
|     | $=$                  | $A\sqrt{B}$    |
| (3) | A                    | A              |
|     | $\times$             | A              |
|     | $\sqrt{\phantom{x}}$ | $\sqrt{A}$     |
|     | B                    | B              |
|     | $=$                  | $A \cdot B$    |
| (4) | $-$                  | 0.             |
|     | A                    | A              |
|     | $=$                  | - A            |
|     | $\sqrt{\phantom{x}}$ | $\sqrt{A} (E)$ |

|     | Key Op.                         | Display            | Memory |
|-----|---------------------------------|--------------------|--------|
| (5) | A                               | A                  | 0.     |
|     | $\boxed{M+}$                    | A (M)              | A      |
|     | $\boxed{M^R_C}$ or $\boxed{MR}$ | A (M)              | A      |
|     | $\boxed{\div}$                  | A (M)              | A      |
|     | B                               | B (M)              | A      |
|     | $\boxed{+/-}$                   | - B (M)            | A      |
|     | $\boxed{\sqrt{\phantom{x}}}$    | $\sqrt{B} (M^M_E)$ | A      |
|     | $\boxed{ON/C/CE}$               | 0. (M)             | A      |

11. Percentage calculation

|     |                  |                       |
|-----|------------------|-----------------------|
| (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                     |
|     | $\boxed{\%}$     | $A - A \cdot B / 100$ |
|     | $\boxed{-}$      | $A - A \cdot B / 100$ |
|     | $\boxed{+}$      | $A - A \cdot B / 100$ |

|                   | Key Op.                                               | Display                                                                                                 | Memory         |
|-------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------|
|                   | C                                                     |                                                                                                         |                |
|                   | <div>%</div>                                          | $\left(A - \frac{A \cdot B}{100}\right)^C + \frac{\left(A - \frac{A \cdot B}{100}\right) \cdot C}{100}$ |                |
| 12.Key correction |                                                       |                                                                                                         |                |
| (1)               | A                                                     | A                                                                                                       | 0.             |
|                   | <div>×</div>                                          | A                                                                                                       | 0.             |
|                   | <div>÷</div>                                          | A                                                                                                       | 0.             |
|                   | <div>−</div>                                          | A                                                                                                       | 0.             |
|                   | <div>+</div>                                          | A                                                                                                       | 0.             |
|                   | <div>√</div>                                          | $\sqrt{A}$                                                                                              | 0.             |
|                   | <div>M+</div>                                         | $A + \sqrt{A} (M)$                                                                                      | $A + \sqrt{A}$ |
|                   | <div>+ / −</div>                                      | $- (A + \sqrt{A}) (M)$                                                                                  | $A + \sqrt{A}$ |
|                   | <div>M<sup>R</sup><sub>C</sub></div> or <div>MR</div> | $A + \sqrt{A} (M)$                                                                                      | $A + \sqrt{A}$ |
|                   | <div>M<sup>R</sup><sub>C</sub></div> or <div>MR</div> | $A + \sqrt{A}$                                                                                          | 0.             |
|                   | B                                                     | B                                                                                                       | 0.             |
|                   | <div>+</div>                                          | B                                                                                                       | 0.             |
|                   | <div>−</div>                                          | B                                                                                                       | 0.             |
|                   | <div>×</div>                                          | B                                                                                                       | 0.             |
|                   | <div>÷</div>                                          | B                                                                                                       | 0.             |
|                   | <div>=</div>                                          | 1 / B                                                                                                   | 0.             |
| 13.Others         |                                                       |                                                                                                         |                |
| (1)               | A                                                     | A                                                                                                       |                |
|                   | <div>+</div>                                          | A                                                                                                       |                |
|                   | <div>=</div>                                          | A                                                                                                       |                |
| (2)               | A                                                     | A                                                                                                       |                |
|                   | <div>×</div>                                          | A                                                                                                       |                |
|                   | <div>÷</div>                                          | A                                                                                                       |                |
|                   | <div>=</div>                                          | 1 / A                                                                                                   |                |
| (3)               | A                                                     | A                                                                                                       |                |
|                   | <div>÷</div>                                          | A                                                                                                       |                |

|     | Key Op.                | Display | Memory |
|-----|------------------------|---------|--------|
|     | <div>+</div>           | A       |        |
|     | <div>=</div>           | A       |        |
| (4) | A                      | A       |        |
|     | <div>×</div>           | A       |        |
|     | <div>−</div>           | A       |        |
|     | <div>=</div>           | − A     |        |
| (5) | A                      | A       |        |
|     | <div>÷</div>           | A       |        |
|     | <div>−</div>           | A       |        |
|     | <div>=</div>           | − A     |        |
| (6) | A                      | A       |        |
|     | <div>×</div>           | A       |        |
|     | <div>ON / C / CE</div> | 0.      |        |
|     | B                      | B       |        |
|     | <div>=</div>           | B       |        |
| (7) | A                      | A       |        |
|     | <div>×</div>           | A       |        |
|     | B                      | B       |        |
|     | <div>ON / C / CE</div> | 0.      |        |
|     | C                      | C       |        |
|     | <div>=</div>           | A·C     |        |

14.Delta Percentage key function

|     |               |                 |  |
|-----|---------------|-----------------|--|
| (1) | A             | A               |  |
|     | <div>+</div>  | A               |  |
|     | B             | B               |  |
|     | <div>Δ%</div> | (A + B) / B·100 |  |
| (2) | A             | A               |  |
|     | <div>÷</div>  | A               |  |
|     | B             | B               |  |

|     | Key Op.    | Display                   | Memory |
|-----|------------|---------------------------|--------|
|     | $\Delta\%$ | $A / (1 - B / 100)$       |        |
|     | $\Delta\%$ | $ A / (1 - B / 100) - A $ |        |
| (3) | A          | A                         |        |
|     | $\times$   | A                         |        |
|     | B          | B                         |        |
|     | $\Delta\%$ | $A (1 + B / 100)$         |        |
| (4) | A          | A                         |        |
|     | $\times$   | A                         |        |
|     | B          | B                         |        |
|     | $+ / -$    | $- B$                     |        |
|     | $\Delta\%$ | $A (1 - B / 100)$         |        |

Key Chattering Protection

- (1) At time of key on : about 6.2~9.5 ms, after key input (f $\phi$  typ.)
- (2) At time of key off : about 30.8 ms, after completion of the operation (f $\phi$  typ.)
- (3) Simultaneous keying protection.  
If 2 or more keys are pressed simultaneously, any key input is not accepted.

## MAXIMUM RATINGS

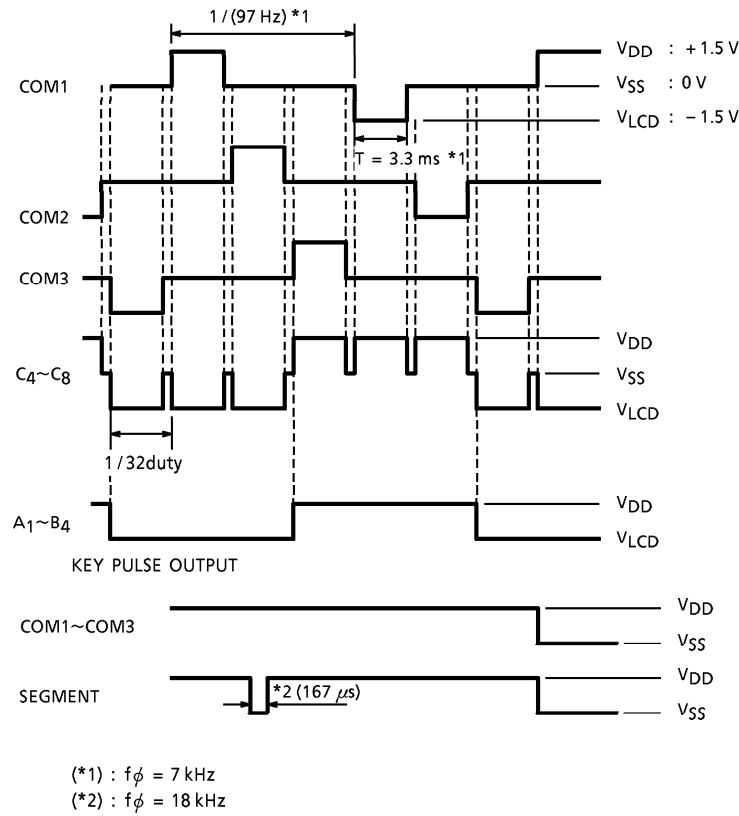
| CHARACTERISTICS       | SYMBOL    | RATING                   | UNIT |
|-----------------------|-----------|--------------------------|------|
| Supply Voltage        | $V_{DD}$  | $-0.3 \sim +2.1$         | V    |
| Input Voltage         | $V_{IN}$  | $-0.3 \sim V_{DD} + 0.3$ | V    |
| Operating Temperature | $T_{opr}$ | $0 \sim 40$              | °C   |
| Storage Temperature   | $T_{stg}$ | $-55 \sim 125$           | °C   |

ELECTRICAL CHARACTERISTICS ( $V_{DD} = 1.4 \text{ V} \pm 0.2 \text{ V}$ ,  $V_{SS} = 0 \text{ V}$ ,  $T_a = 25^\circ\text{C}$ )

| CHARACTERISTICS            |     | SYMBOL              | TEST CIR-<br>CUIT | PIN<br>NAME                         | TEST CONDITION                                           | MIN                   | TYP. | MAX                   | UNIT |     |
|----------------------------|-----|---------------------|-------------------|-------------------------------------|----------------------------------------------------------|-----------------------|------|-----------------------|------|-----|
| Operating Voltage          |     | V <sub>DD</sub>     | —                 | —                                   | —                                                        | 1.1                   | 1.4  | 1.9                   | V    |     |
| “1” Input Voltage          |     | V <sub>IH</sub>     | —                 | K <sub>1</sub> ~ $\overline{K_3}$   | —                                                        | V <sub>DD</sub> - 0.4 | —    | V <sub>DD</sub>       | V    |     |
| “0” Input Voltage          |     | V <sub>IL</sub>     | —                 | K <sub>1</sub> ~ $\overline{K_3}$   | —                                                        | 0                     | —    | 0.4                   | V    |     |
| “1” Output Voltage         |     | V <sub>OH</sub>     | —                 | Segment<br>Common                   | —                                                        | V <sub>DD</sub> - 0.2 | —    | V <sub>DD</sub>       | V    |     |
| “0” Output Voltage         |     | V <sub>OL</sub>     | —                 | Segment<br>Common                   | —                                                        | V <sub>DD</sub> + 0.2 | —    | -V <sub>DD</sub>      | V    |     |
| “1” Output Voltage         |     | V <sub>OH</sub>     | —                 | $\overline{K_2}$ ~ $\overline{K_3}$ | —                                                        | V <sub>DD</sub> - 0.2 | —    | V <sub>DD</sub>       | V    |     |
| “0” Output Voltage         |     | V <sub>OL</sub>     | —                 | K <sub>1</sub>                      | —                                                        | 0                     | —    | 0.2                   | V    |     |
| “M” Output Voltage         |     | V <sub>OM</sub>     | —                 | Common                              | —                                                        | V <sub>SS</sub> + 0.2 | —    | V <sub>SS</sub> - 0.2 | V    |     |
| Output Resistance          | “1” | R <sub>OH</sub>     | —                 | Segment                             | V <sub>OUT</sub> = V <sub>DD</sub> - 0.5 V<br>Key Strobe | —                     | —    | 70                    | kΩ   |     |
|                            | “0” | R <sub>OL</sub>     | —                 | Segment                             | V <sub>OUT</sub> = V <sub>LCD</sub> + 0.5 V              | —                     | —    | 70                    |      |     |
|                            | “1” | R <sub>OH</sub>     | —                 | Common                              | V <sub>OUT</sub> = V <sub>DD</sub> - 0.5 V               | —                     | —    | 70                    |      |     |
|                            | “0” | R <sub>OL</sub>     | —                 | Common                              | V <sub>OUT</sub> = V <sub>LCD</sub> + 0.5 V              | —                     | —    | 70                    |      |     |
| Output Resistance          | “M” | R <sub>OM</sub>     | —                 | Common                              | V <sub>OUT</sub> = V <sub>SS</sub> + 0.5 V               | —                     | —    | 10                    | kΩ   |     |
| Key Pull Down Resistance   |     | R pull down         | —                 | K <sub>1</sub>                      | V <sub>OUT</sub> = V <sub>DD</sub>                       | 45                    | 80   | 240                   | kΩ   |     |
| Key Pull up Resistance     |     | R pull up           | —                 | $\overline{K_2}$ ~ $\overline{K_3}$ | V <sub>OUT</sub> = 0V                                    | 45                    | 80   | 240                   | kΩ   |     |
| “0” Output Resistance      |     | R <sub>KEY</sub>    | —                 | Segment                             | V <sub>OUT</sub> = V <sub>SS</sub> + 0.5 V<br>Key Strobe | —                     | —    | 10                    | kΩ   |     |
| Input Leakage Current      |     | I <sub>IL</sub>     | —                 | K <sub>0</sub>                      | 0 ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>                    | —                     | —    | ± 1.0                 | μA   |     |
| Current Consumption (Wait) |     | I <sub>DD1</sub>    | —                 | —                                   | V <sub>DD</sub> = 1.4 V (Key Open)                       | —                     | 1.9  | 3.3                   | μA   |     |
| Current Consumption (OP)   |     | I <sub>DD2</sub>    | —                 | —                                   | V <sub>DD</sub> = 1.1 V<br>(ALL 9 $\sqrt{\quad}$ Peak)   | —                     | 3.0  | 4.0                   | μA   |     |
| Current Consumption (OFF)  |     | I <sub>DD OFF</sub> | —                 | —                                   | V <sub>DD</sub> = 1.4 V                                  | —                     | —    | 1.0                   | μA   |     |
| Oscillating Frequency      |     | fϕ (Wait)           | —                 | —                                   | V <sub>DD</sub>                                          | fϕ (Typ.) = Wait      | 4.2  | 7                     | 9.8  | kHz |
|                            |     | = 1.4 V             |                   |                                     | fϕ (Typ.) = Operate                                      | 10.8                  | 18   | 25.2                  |      |     |
| Frame Frequency            |     | f <sub>F</sub>      | —                 | —                                   | V <sub>DD</sub> = 1.4 V (Wait)                           | 58                    | 97   | 136                   | Hz   |     |
| Power off Timer            |     | Timer               | —                 | —                                   | V <sub>DD</sub> = 1.4 V                                  | 300                   | 420  | 700                   | s    |     |

WAVEFORMS FOR DISPLAY

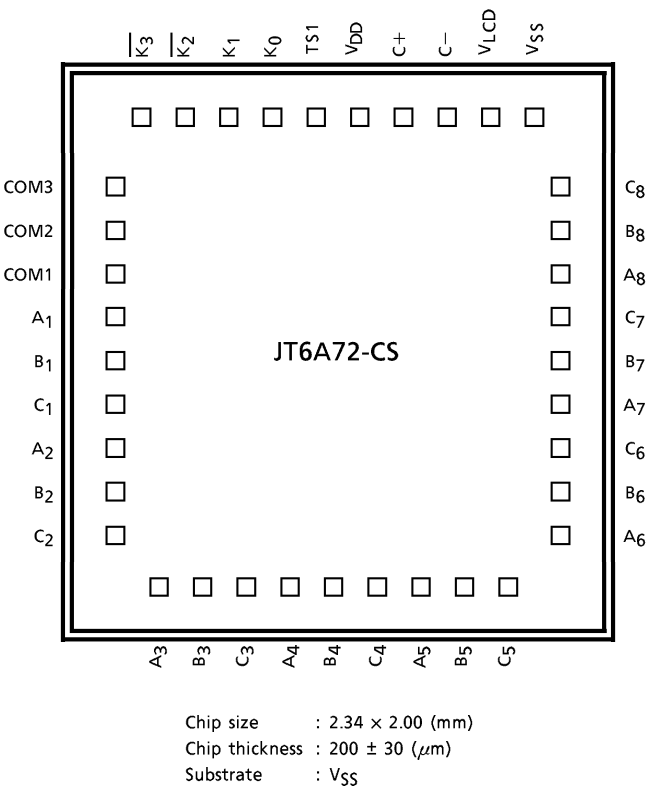
Display Device : FEM type LCD 3.0 V, 1/2 bias, 1/3 duty dynamic system



PAD LOCATION TABLE ( $\mu\text{m}$ )

| NAME             | X POINT | Y POINT |
|------------------|---------|---------|
| C <sub>2</sub>   | - 1049  | - 697   |
| B <sub>2</sub>   | - 1049  | - 515   |
| A <sub>2</sub>   | - 1049  | - 353   |
| C <sub>1</sub>   | - 1049  | - 172   |
| B <sub>1</sub>   | - 1049  | - 10    |
| A <sub>1</sub>   | - 1049  | 171     |
| COM1             | - 1049  | 362     |
| COM2             | - 1049  | 549     |
| COM3             | - 1049  | 713     |
| $\overline{K_3}$ | - 809   | 879     |
| $\overline{K_2}$ | - 627   | 879     |
| K <sub>1</sub>   | - 466   | 879     |
| K <sub>0</sub>   | - 284   | 879     |
| TS1              | - 123   | 879     |
| V <sub>DD</sub>  | 45      | 879     |
| C +              | 229     | 879     |
| C -              | 464     | 879     |
| V <sub>LCD</sub> | 736     | 879     |
| V <sub>SS</sub>  | 910     | 879     |
| C <sub>8</sub>   | 1049    | 703     |
| B <sub>8</sub>   | 1049    | 516     |
| A <sub>8</sub>   | 1049    | 351     |
| C <sub>7</sub>   | 1049    | 164     |
| B <sub>7</sub>   | 1049    | - 1     |
| A <sub>7</sub>   | 1049    | - 188   |
| C <sub>6</sub>   | 1049    | - 353   |
| B <sub>6</sub>   | 1049    | - 540   |
| A <sub>6</sub>   | 1049    | - 705   |
| C <sub>5</sub>   | 721     | - 879   |
| B <sub>5</sub>   | 555     | - 879   |
| A <sub>5</sub>   | 369     | - 879   |
| C <sub>4</sub>   | 203     | - 879   |
| B <sub>4</sub>   | - 110   | - 879   |
| A <sub>4</sub>   | - 263   | - 879   |
| C <sub>3</sub>   | - 444   | - 879   |
| B <sub>3</sub>   | - 606   | - 879   |
| A <sub>3</sub>   | - 788   | - 879   |

CHIP LAYOUT



PAD LAYOUT

