# Calculator LSI

# C9318LA

## GENERAL DESCRIPTION

C9318LA is a CMOS LSI calculator chip with 8 digits arithmetic operations, single memory, extraction-of-square-root percentage calculation and punctuation function, designed for triplex LCD application with solar cell power supply.

## APPLICATION

This specification contains complete informations of functional operations, electrical characteristics, packaging, and crating requirements of C9318LA.

## FUNCTIONS

- Four standard functions (+, -, x, ÷).
- Auto-constant calculations (constant : multiplicand, divisor, addend and subtrahend).
- Square and reciprocal calculations.
- Mark-up and mark-down calculations.
- Extraction of square root.
- Percentage calculations.
- Chain multiplication and division.
- Power calculations.
- Rough estimate calculations.
- Punctuation comma display.

## FEATURES

- Accumulating memory : M+, M-, RM, CM, RM/CM.
- Rollover capability.
- Floating decimal.
- Overflow indication.
- 8-digit LCD triplex.
- Automatic power off function.

## FUNCTIONAL DESCRIPTION

a. **Floating point system**

i) 8 digits floating decimal point system, with leading zero suppression, Zero shift.

ii) Symbols : '-' negative number indicator.

: 'E' Error status indicator.

: '9' punctuation comma

: 'M' Non-zero memory indicator.

b. **Error Detections**

i) System errors occur when :

- The integral part of any calculation result exceeds 8 digits.
- The integral part of any memory calculation result exceeds 8 digits.
- The integral part of any addend or subtrahend to memory exceed 8 digits.
- The integral part of a mark-up or mark-down calculation result exceeds 8 digits.
- The division by zero.
- The extraction of square root of a negative number.

ii) Rough estimate calculation error

- The integral part of the result of any standard functions, percentage, square, reciprocal or power calculations exceeds 8 digits and is equal to 16 digits or less.

c. **Error Indication**

i) System error

'0' is indicated in the 1-digit position and 'E' in the sign indicator position.

ii)Rough estimate calculation error

The high-order 8 digits of a calculation result is indicated together with 'E'. The decimal point is indicated in the position corresponding to a calculation result times $10^{-8}$, and no zero shift is performed.

d. **Error Release**

i) System error can be released by the ON/C or ON/CE key.

ii)Rough estimate calculation error can be released by the ON/C, ON/CE, CE key.

e. **Number Entry**

Numerical can be entered up to 8 digits, entries that equal to 9 digits or more will be ignored.

f. **Memory Protection**

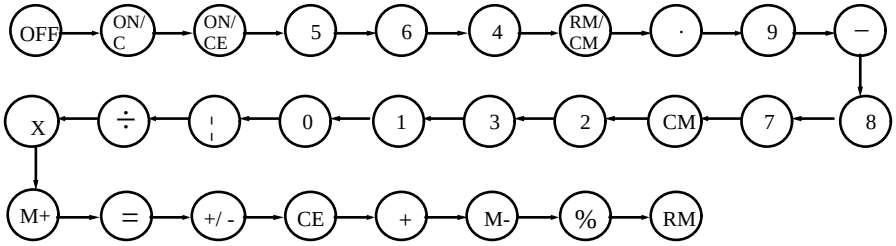
The memory contents before any error detection are protected.

g. **Memory Indication**

If the memory contents is non-zero, 'M' is indicated in the memory indicator position.

h. **Double Key Depression**

The order of priority when two keys are being depressed simultaneously is as follows :




When the OFF and ON/C key are depressed simultaneously, the OFF key is given priority.

i. **Key bounce protection**

i) Front edge : down to 1 word and up to about 3 words.

ii)Trailing edge : 9 words. ( 1 word is 3.3ms when display frequency is Fd=100Hz. )

j. **Auto Power Off**

Power automatically turns off after 9 - 11 minutes pass from the last key press.

k. **Clear Operation**

All operations except memory content are cleared by ON/C key.

## ABSOLUTE MAXIMUM RATINGS

| Parameters | Symbol | Value | Unit | Note |
|---|---|---|---|---|
| Terminal voltage | $V_{DD}$ | - 0.3 ~ + 2.0 | V | 1 |
| | $V_{IN}$ | - 0.3 ~ $V_{DD}$ + 0.3 | V | 1 |
| Solar Supply Voltage | VSB | 1.1 ~ 3.0 | V | 2 |
| | VGG (LIM) | 1.1 ~ 1.8 | V | 3 |

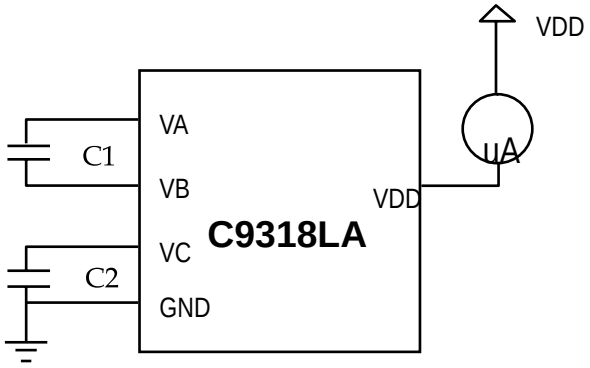
Note 1 : Maximum voltage on any pin is referenced to GND.
Note 2 :VSB is solar supply voltage.
Note 3 :VGG (lim) is limited voltage.

## ELECTRICAL CHARACTERISTICS

( Ta = 25°C, $V_{DD}$ = 1.5V unless otherwise specified)

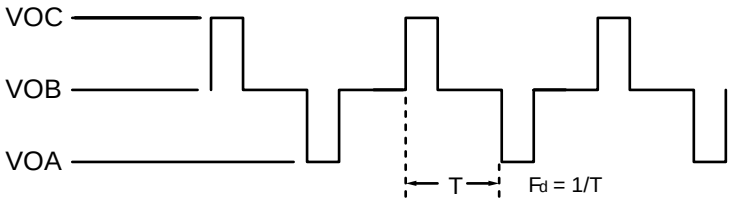
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Test Condition | Note |
|---|---|---|---|---|---|---|---|
| Input Voltage | $V_{IH}$ | $V_{DD}$-0.4 | -- | -- | V | -– | 4 |
| | $V_{IL}$ | -- | -- | 0.4 | V | -- | |
| Input Current | $I_{IH}$ | -- | -- | 1 | µA | $V_{IN} = V_{DD}$ | 5 |
| | $I_{IL}$ | 0.3 | 1 | 3 | µA | $V_{IN}$ = 0V | |
| Output Voltage 1 | $V_{OH}$ | $V_{DD}$-0.15 | -- | -- | V | No load | 6 |
| | $V_{OL}$ | -- | -- | 0.15 | V | $I_{OUT}$ = 15µA | |
| Output Voltage 2 | $V_{OA}$ | 2.8 | 2.95 | -- | V | No load | 7 |
| | $V_{OB}$ | 1.3 | 1.5 | 1.7 | V | No load | |
| | $V_{OC}$ | -- | 0 | 0.2 | V | No load | |
| Display Frequency | Fd | 40 | 65 | 85 | Hz | $V_{DD}$ = 1.3V while display is ON. | 7 |
| Dissipation Current | $I_{OFF}$ | -- | -- | 0.1 | µA | Display is OFF | 8 |
| | $I_{DIS}$ | -- | 4.2 | 6 | µA | $V_{DD}$ = 1.3V while display is on. | 9 |
| | $I_{OP}$ | -- | 6.8 | -- | µA | $V_{DD}$ = 1.1V , while operation. | 10 |

Note 4 : Applies to Pins K2 ~ K6.
Note 5 : Applies to Pins K2 ~ K6.
Note 6 : Applies to P1,P2, A2X ~ A5X.
Note 7 : Applies to H1 ~ H3, A1 ~ A8, B1 ~ B8, C1 ~ C8.
Note 8 : Measured by the test circuit below after power supply automatically turns off.




Note 9 : Measured by the test circuit while "0" is being displayed after auto - clear operation and while key is not being depressed.
Note 10 : Measured by the test circuit while operation is being made by ON/C key and while key is not being depressed.

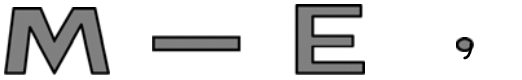
## LCD BACKPLANE OUTPUT WAVEFORM




## DISPLAY FONTS

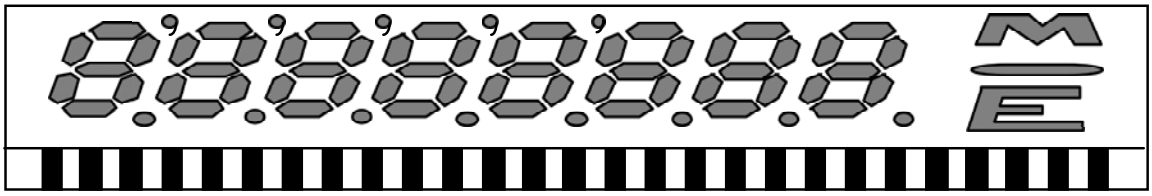
a. **Numerical Font**


b. **Sign Font**

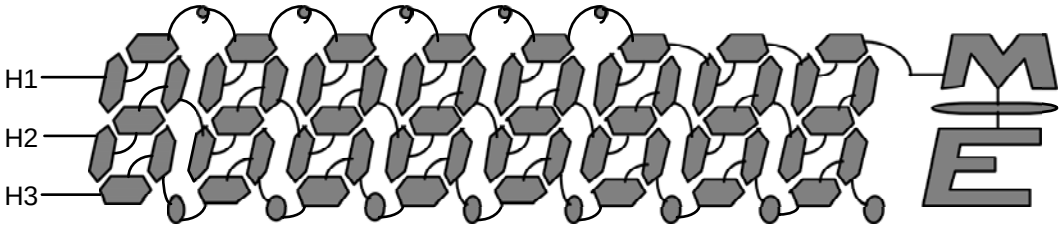



Memory indicator | Negative | Error indicator | Punctuation

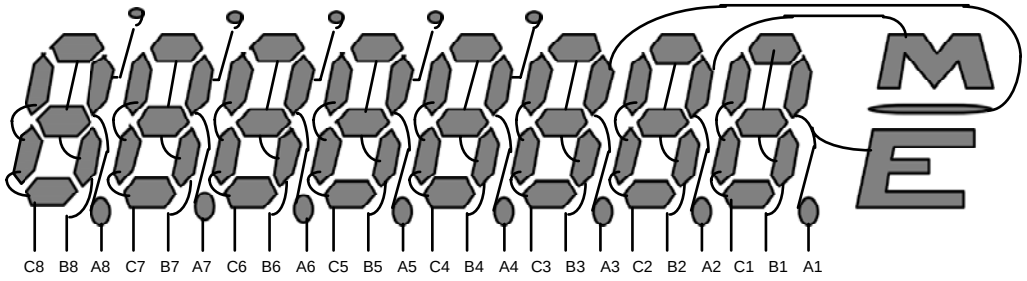
## LCD CONNECTOR




LCD Panel




Backplanes Connection

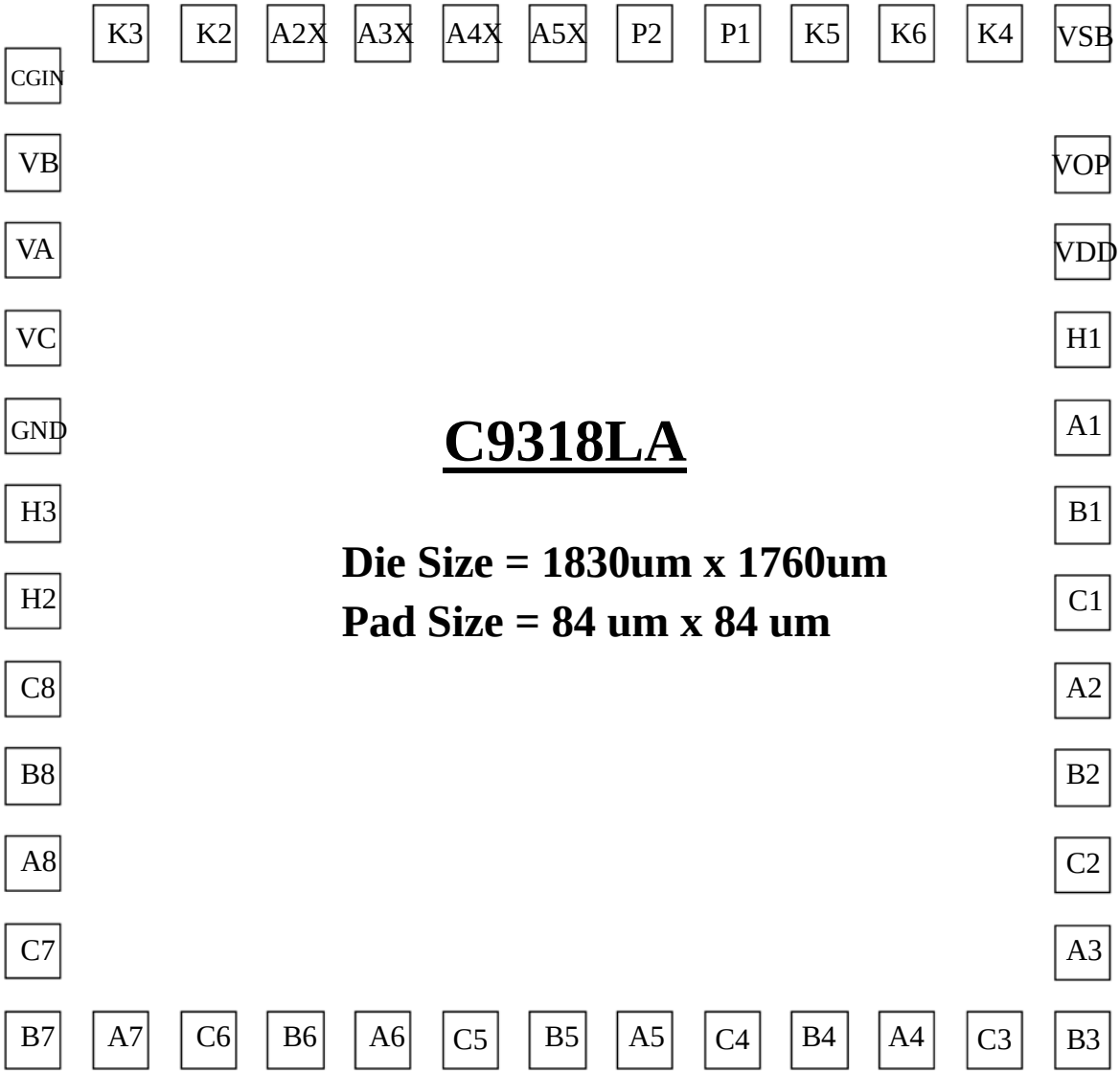



Segment Connection

**PIN DESCRIPTION**

| Pin No. | Signal | I/O | Description | Pin No. | Signal | I/O | Description |
|---|---|---|---|---|---|---|---|
| 1 | VSB | I | Solary Battery | 24 | B7 | O | Display output. |
| 2 | VOP | I | Option Pin | 25 | C7 | O | Display output. |
| 3 | VDD | - | Power supply. | 26 | A8 | O | Display output. |
| 4 | H1 | O | Display output. | 27 | B8 | O | Display output. |
| 5 | A1 | O | Display output. | 28 | C8 | O | Display output. |
| 6 | B1 | O | Display output. | 29 | H2 | O | Display output. |
| 7 | C1 | O | Display output. | 30 | H3 | O | Display output. |
| 8 | A2 | O | Display output. | 31 | GND | - | Ground. |
| 9 | B2 | O | Display output. | 32 | VC | O | Cap terminal for voltage step-up. |
| 10 | C2 | O | Display output. | 33 | VA | O | Cap terminal for voltage step-up. |
| 11 | A3 | O | Display output. | 34 | VB | O | Cap terminal for voltage step-up. |
| 12 | B3 | O | Display output. | 35 | CGin | I | Input terminal for CG. |
| 13 | C3 | O | Display output. | 36 | K3 | I | Key input. |
| 14 | A4 | O | Display output. | 37 | K2 | I | Key input. |
| 15 | B4 | O | Display output. | 38 | A2X | O | Strobe output. |
| 16 | C4 | O | Display output. | 39 | A3X | O | Strobe output. |
| 17 | A5 | O | Display output. | 40 | A4X | O | Strobe output. |
| 18 | B5 | O | Display output. | 41 | A5X | O | Strobe output. |
| 19 | C5 | O | Display output. | 42 | P2 | O | Strobe output. |
| 20 | A6 | O | Display output. | 43 | P1 | O | Strobe output. |
| 21 | B6 | O | Display output. | 44 | K5 | I | Key input. |
| 22 | C6 | O | Display output. | 45 | K6 | I | Key input. |
| 23 | A7 | O | Display output. | 46 | K4 | I | Key input. |

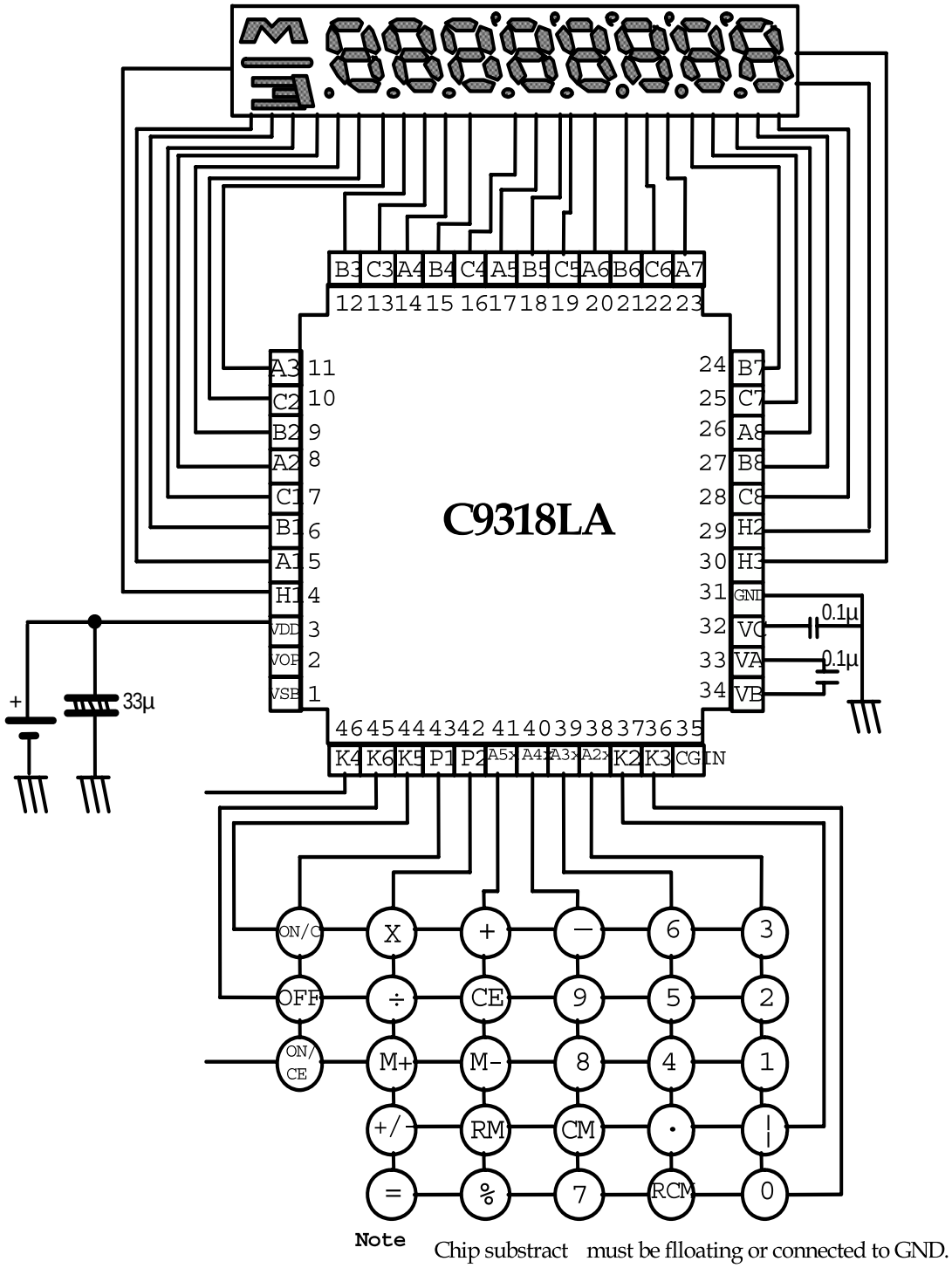
**PAD DIAGRAM**




**The Co-ordinate for Low Left Corner of Each Pad**

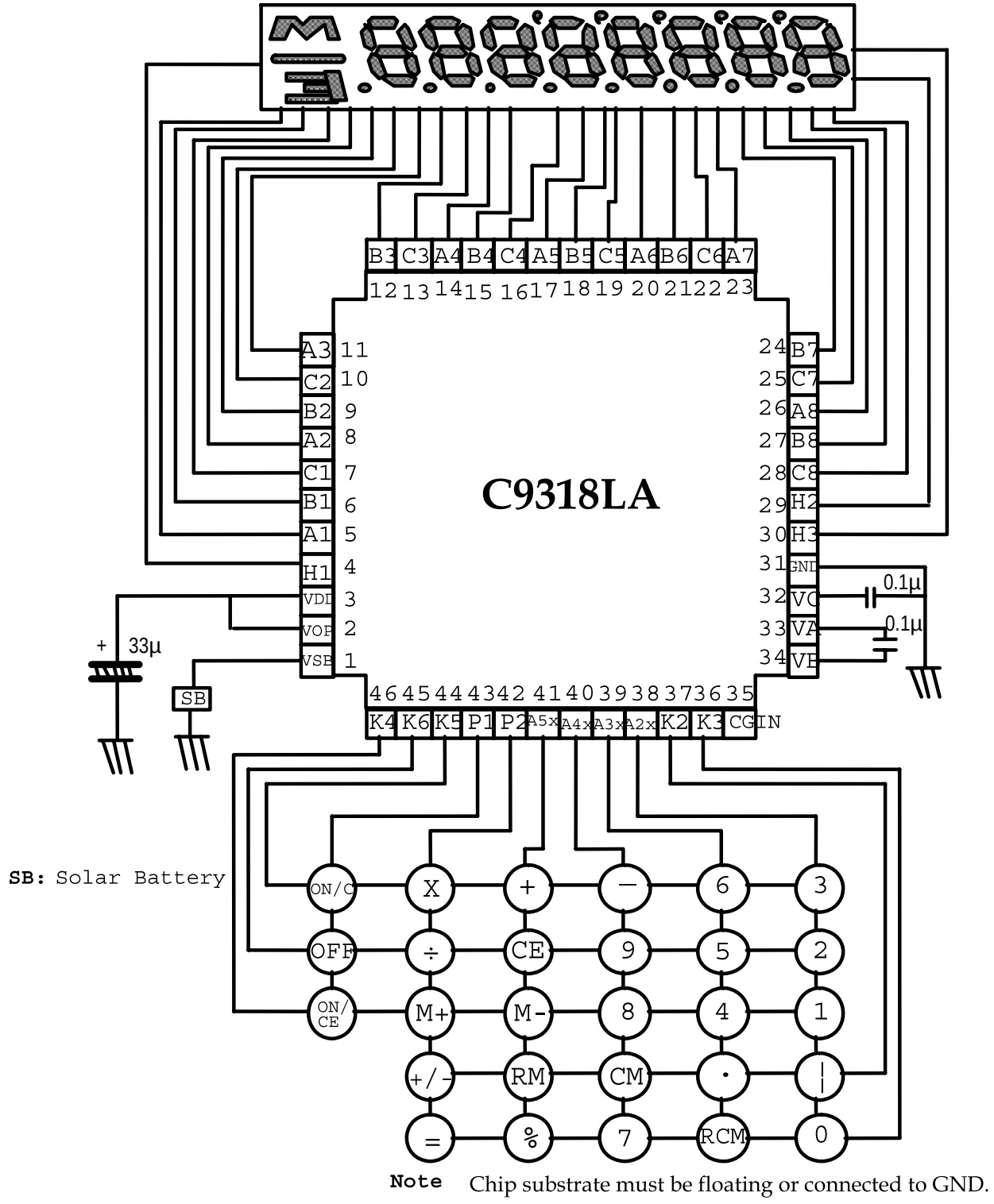
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A7 | (-707.0, | -806.9) | A3 | (756.0, | -673.9) | K4 | (623.0, | 722.9) | CGIN | (-840.0, | 658.6) |
| C6 | (-574.0, | -806.9) | C2 | (756.0, | -540.9) | K6 | (490.0, | 722.9) | VB | (-840.0, | 525.6) |
| B6 | (-441.0, | -806.9) | B2 | (756.0, | -407.9) | K5 | (357.0, | 722.9) | VA | (-840.0, | 392.6) |
| A6 | (-308.0, | -806.9) | A2 | (756.0, | -274.9) | P1 | (224.0, | 722.9) | VC | (-840.0, | 259.6) |
| C5 | (-175.0, | -806.9) | C1 | (756.0, | -141.9) | P2 | (91.0, | 722.9) | GND | (-840.0, | 126.6) |
| B5 | (-42.0, | -806.9) | B1 | (756.0, | -8.9) | A5X | (-42.0, | 722.9) | H3 | (-840.0, | -6.4) |
| A5 | (91.0, | -806.9) | A1 | (756.0, | 124.1) | A4X | (-175.0, | 722.9) | H2 | (-840.0, | -139.4) |
| C4 | (224.0, | -806.9) | H1 | (756.0, | 257.1) | A3X | (-308.0, | 722.9) | C8 | (-840.0, | -272.4) |
| B4 | (357.0, | -806.9) | VDD | (756.0, | 390.1) | A2X | (-441.0, | 722.9) | B8 | (-840.0, | -405.4) |
| A4 | (490.0, | -806.9) | VOP | (756.0, | 523.1) | K2 | (-574.0, | 722.9) | A8 | (-840.0, | -538.4) |
| C3 | (623.0, | -806.9) | VSB | (756.0, | 722.9) | K3 | (-707.0, | 722.9) | C7 | (-840.0, | -671.4) |
| B3 | (756.0, | -806.9) | | | | | | | B7 | (-840.0, | -806.9) |

**APPLICATION DIAGRAM OF BATTERY SUPPLY**




**Note** Chip substract must be flloating or connected to GND.

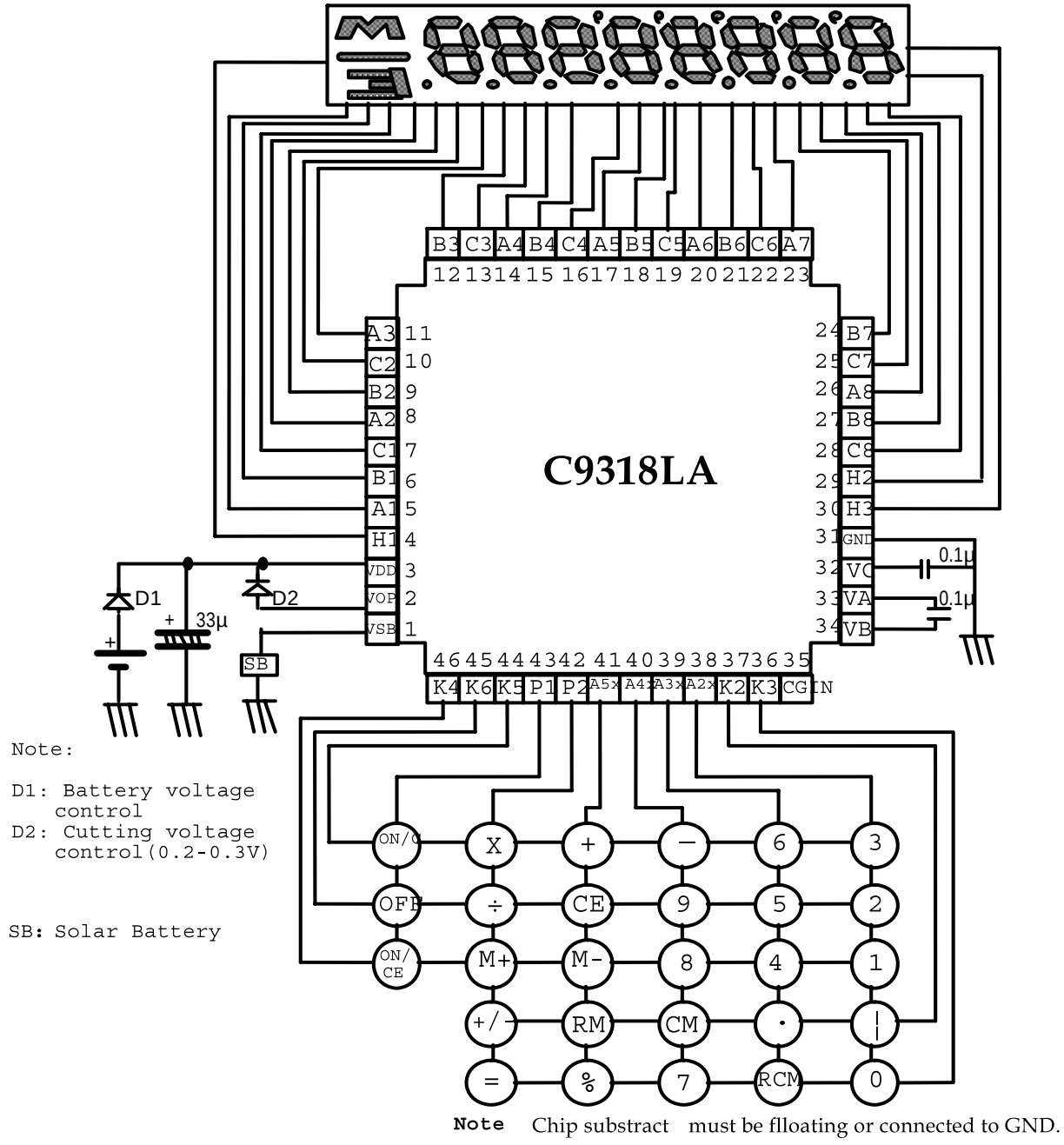
**APPLICATION DIAGRAM OF SOLAR CELL SUPPLY**




**SB:** Solar Battery

**Note** Chip substrate must be floating or connected to GND.

**APPLICATION DIAGRAM OF DUAL POWER SUPPLY**




Note:

D1: Battery voltage control
D2: Cutting voltage control(0.2-0.3V)

SB: Solar Battery

**Note** Chip substract must be flloating or connected to GND.