

# DL5510

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## 10-Digit LCD Calculator With Punctuation

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### GENERAL DESCRIPTION

DL5510 is a CMOS LSI calculator chip with 10 digits arithmetic operations, single memory, extraction-of-square-root percentage calculation, auto power off and punctuation function, designed for FEM LCD operation with 1.5V power supply

### APPLICATION

This specification contains complete information of functional operations, electrical characteristics, packaging, and crating requirements of DL5510

### 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.
- Clear key: ON/C, C, CE.

### FEATURES

- Accumulating memory : M+, M-, RM, CM, RM/CM.
- Single chip CMOS construction.
- Floating decimal point.
- Overflow indication: E
- 10-digit LCD triplex.
- On-chip oscillator components.
- Very low power consumption.
- 1.5V battery or solar cell power supply.
- Automatic power off feature.

### FUNCTIONAL DESCRIPTION

#### a. Floating point system

- i) 10 digits floating decimal point system, with leading zero suppression, Zero shift.
- ii) Symbols : '-' negative number indicator.  
: 'E' Error status indicator.  
: 'M' Non-zero memory indicator.  
: '9' punctuation comma

#### b. Error Detections

- i) System errors occur when :
  - The integral part of any calculation result exceeds 10 digits.
  - The integral part of any memory calculation result exceeds 10 digits.
  - The integral part of any addend or subtrahend to memory exceed 10 digits.
  - The integral part of a mark-up or mark-down calculation result exceeds 10 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 root, reciprocal or power calculations result exceed 10 digits.

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

## d. Error Release

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

ii) ON/C or C key can release a rough estimate calculation error and clear calculation result at once.

CE key can release only a rough estimate calculation error ("E" flag).

## e. Number Entry

Numerical can be entered up to 10 digits, Numerical entries that equal to 11 digits or more will be ignored.

## f. Memory Protection

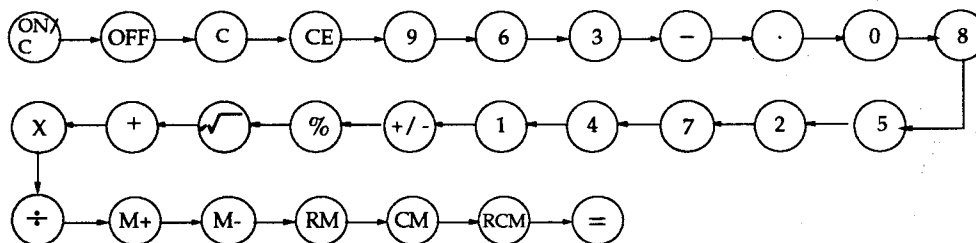
The memory contents present before any error detection are protected.

## g. Memory Indication

If the memory content 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 :



## i. Key bounce protection

i) Front edge : Minimum 3 words.

ii) Trailing edge : Minimum 16 words. ( 1 word is 3.3ms when display frequency is  $F_d=100\text{Hz}$ .)

## j. Auto Power Off

Power automatically turns off after 5-6 minutes pass from the last key pressed. By connecting the APODIS pin to GND or VGG, the auto power off function is disabled or enabled, respectively.

## k. Clear Operation

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

### l. CE Key

CE key can edit the last operand or operator.

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## ABSOLUTE MAXIMUM RATINGS

Parameters	Symbol	Value	Unit	Note
Terminal voltage	VDD	- 0.3 ~ + 2.1	V	1
	VIN	- 0.3 ~ VDD + 0.3		
Supply Voltage	VDD	1.1~ 1.8	V	—
Operating temperature range	TOPR	0 ~ + 50	°C	—
Storage temperature range	TSTG	- 55 ~ + 125	°C	—

Note 1 : Maximum voltage on any pin is referenced to GND.

## ELECTRICAL CHARACTERISTICS

( Ta = 25°C, VDD = 1.5V unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Note
Input Voltage 1	VIH1	VDD-0.4	—	—	V	—	2
	VIL1	—	—	0.4		—	
Input Voltage 2	VIH2	VCC-0.8	—	—	V	Vcc=3v	3
	VIL2	—	—	0.4		Vcc=3v	
Input Current 1	I IH1	0.3	1	3	uA	Vin=0v, power off	2
	I IL1	—	--	1		Vin=VDD, power off	
Input Current 2	I IH2	0.3	1	3	uA	Vin = 0v	3
	I IL2	—	--	1		Vin = Vcc(3v)	
Output Voltage	VOA	2.80	2.95	—	V	No load	4
	VOB	1.30	1.50	1.70		No load	
	Voc	—	0	0.20		No load	
Display Frequency	Fd	40	65	—	Hz	VDD = 1.3V, while display is ON.	
Dissipation	I OFF	--	--	0.1	uA	Display is OFF	5
	I DIS	--	2	4		VDD = 1.3V, without load	6
	I OP	—	3	--		VDD = 1.1V, without load	7

Note 2 : Applies to Pins FDIS, K2, TEST, EXT.

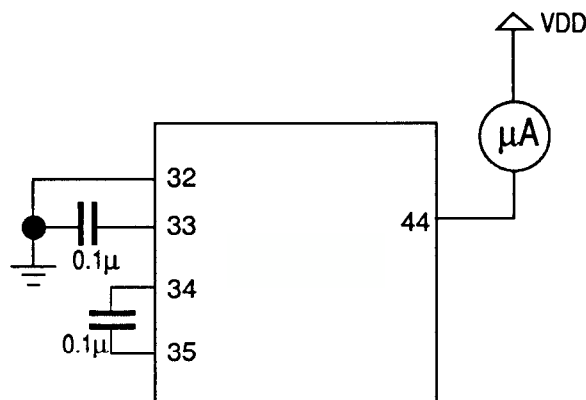
Note 3 : Applies to Pins K4 ~ K6 .

Note 4 : Applies to a1~a10, b1 ~ b10 ,c1~c10, H1~H3.

Note 5 : Measured by the below test circuit after power supply automatically turns off.

Note 6 : Measured by the below test circuit while "0" is being displayed after auto-clear operation and while no key is being depressed.

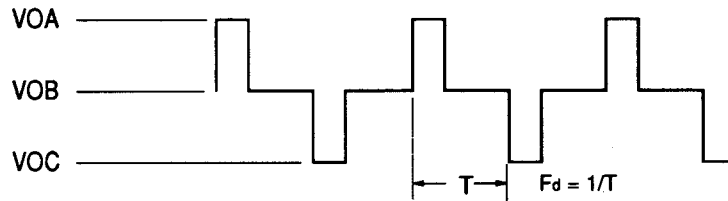
Note 7 : Measured by the below test circuit while operation is being made by ON/C key and while no key is being depressed.



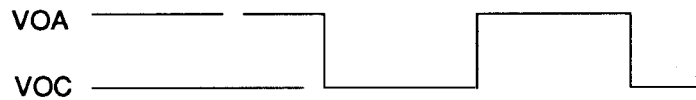
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## LCD BACKPLANE OUTPUT WAVEFORM 1; HI (i=1,2,3)

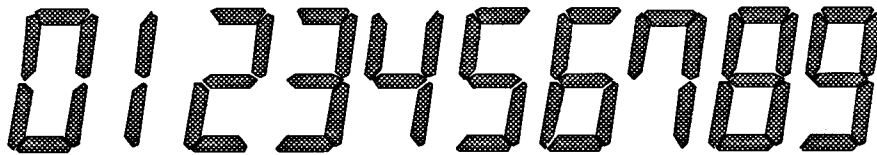


## LCD BACKPLANE OUTPUT WAVEFORM 2; ai, bi, ci (i=1,2, - - - 10)

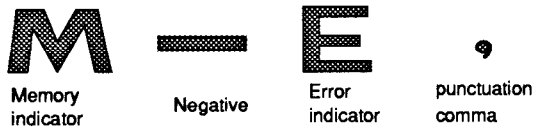


## DISPLAY FONTS

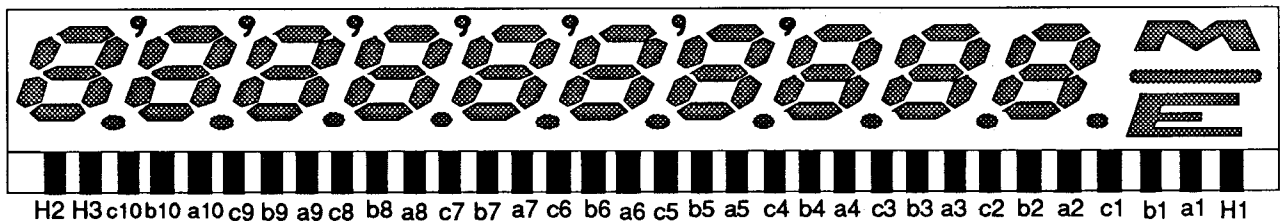
### a. Numerical Font



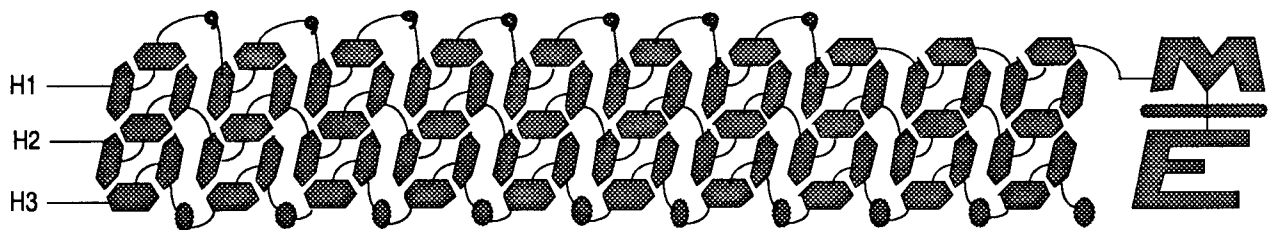
### b. Sign Font



## LCD CONNECTOR



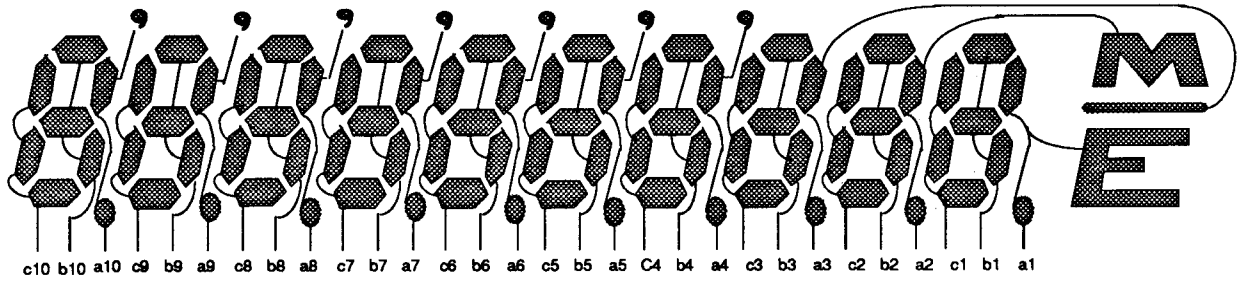
### LCD Panel



### Backplanes Connection

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## Segment Connection

### MARK-UP AND MARK-DOWN CALCULATION

Mark-up and mark-down calculation are performed as follows.

ENTRY		DISPLAY	
A	A	A	A
+ OR -	X	A	A
B	B	B	B
%	%	A+AM/100 OR A-AM/100	*AM/100
	+ OR -		AM/100
	=		A+AM/100 or A-AM/100

\* AM : AMOUNT

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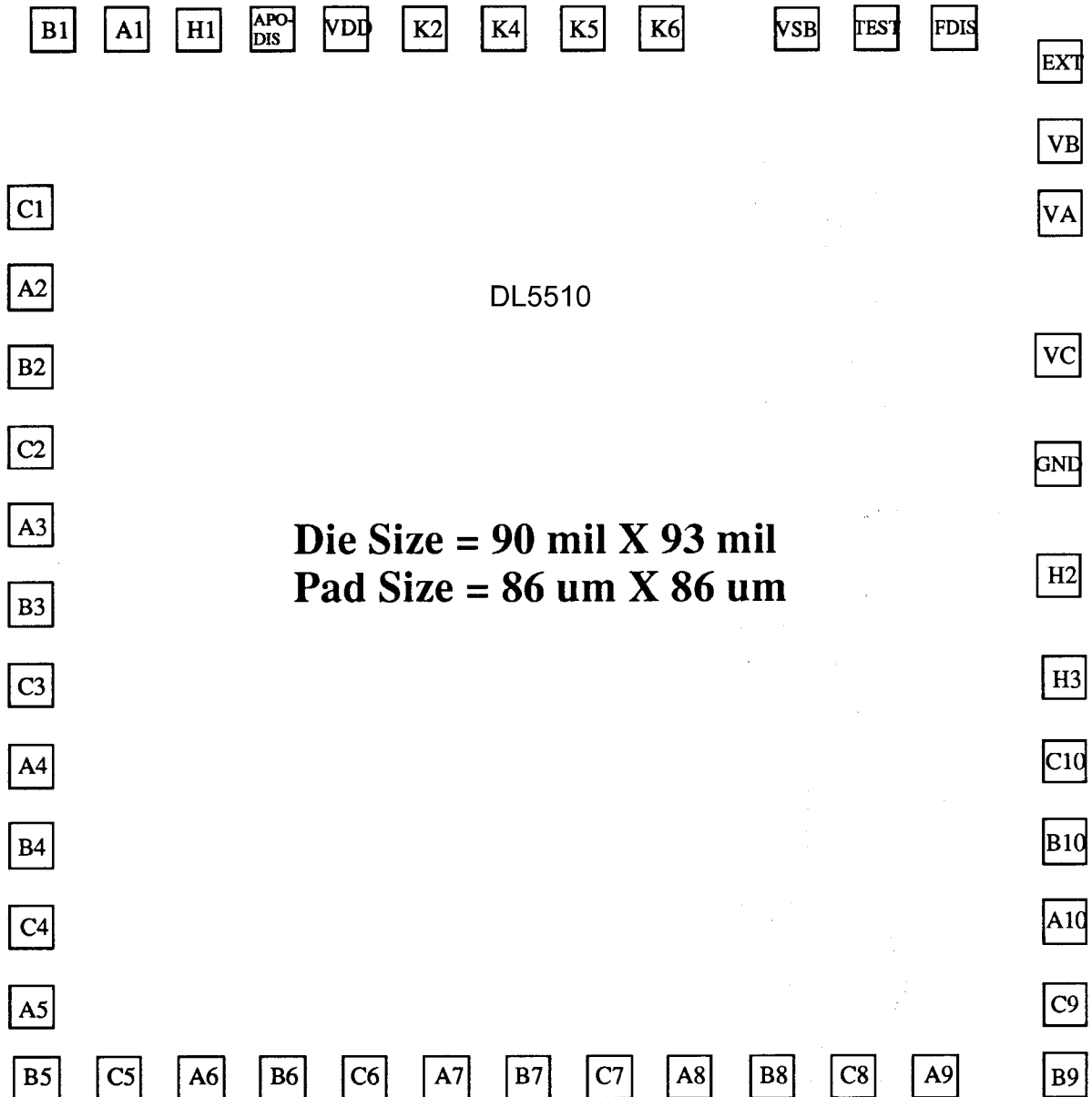
## PIN DESCRIPTION

Pin No.	Signal	I/O	Description	Pin No.	Signal	I/O	Description
1	c1	O	Display output.	25	b9	O	Display output/Strobe 5.
2	a2	O	Display output.	26	c9	O	Display output/Strobe 4.
3	b2	O	Display output.	27	a10	O	Display output/Strobe 3.
4	c2	O	Display output.	28	b10	O	Display output/Strobe 2.
5	a3	O	Display output.	29	c10	O	Display output/Strobe 1.
6	b3	O	Display output.	30	H3	O	COMMON 3.
7	NC	-	No connection	31	H2	O	COMMON 2.
8	c3	O	Display output.	32	GND		Ground.
9	a4	O	Display output.	33	VC	O	Capacitor pin for voltage set-up.
10	b4	O	Display output.	34	VA	O	Capacitor pin for voltage set-up.
11	c4	O	Display output.	35	VB	O	Capacitor pin for voltage set-up.
12	a5	O	Display output.	36	EXT	I	External clock.
13	b5	O	Display output.	37	FDIS	I	Fosc & frequency doubler disable
14	c5	O	Display output.	38	TEST	I	TEST pin.
15	a6	O	Display output.	39	VSB		Solar cell power supply
16	b6	O	Display output.	40	K6	I	Key input.
17	c6	O	Display output.	41	K5	I	Key input.
18	a7	O	Display output.	42	K4	I	Key input.
19	b7	O	Display output.	43	K2	I	Key input.
20	c7	O	Display output.	44	VDD		Power supply.
21	a8	O	Display output /Strobe 9.	45	APODIS	I	Auto power off disable.
22	b8	O	Display output /Strobe 8.	46	H1	O	COMMON 1.
23	c8	O	Display output /Strobe 7.	47	a1	O	Display output.
24	a9	O	Display output /Strobe 6.	48	b1	O	Display output.

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## PAD DIAGRAM



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

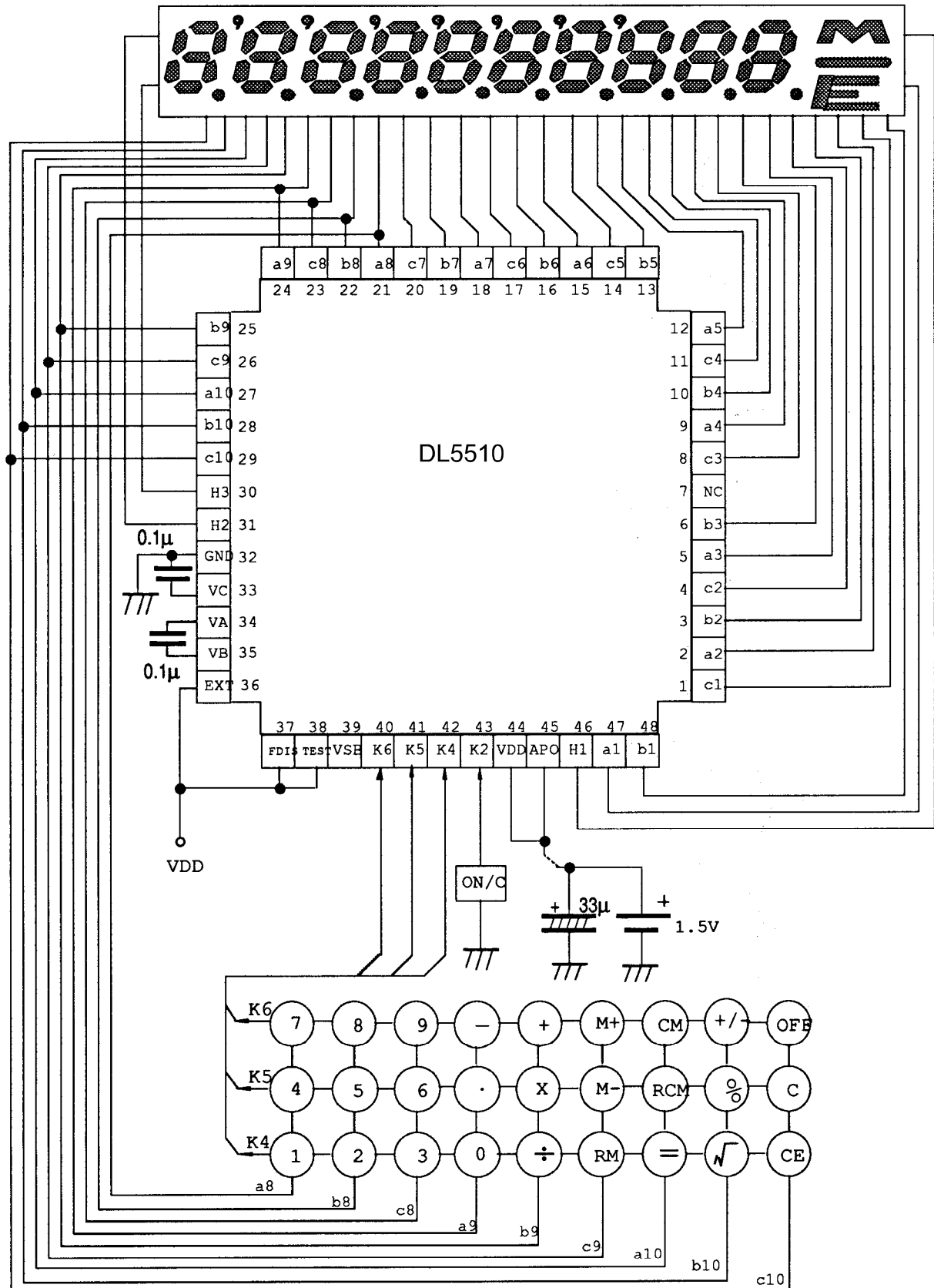
B5(-1043.9, -1086.1)	B9 (967.0, -1085.0)	FDIS ( 752.4, 1002.1)	C1(-1054.4, 651.6)
C5( -884.9, -1086.1)	C9 (968.4, -942.6)	TEST ( 599.6, 1002.1)	A2(-1054.4, 490.7)
A6( -724.0, -1086.1)	A10 (968.4, -779.8)	VSB ( 445.1, 1002.0)	B2(-1054.4, 333.4)
B6( -566.0, -1086.1)	B10 (968.4, -621.7)	K6 ( 179.3, 1002.1)	C2(-1054.4, 172.5)
C6( -404.5, -1086.1)	C10 (968.4, -460.8)	K5 ( 24.6, 1002.1)	A3(-1054.4, 14.4)
A7( -245.5, -1086.1)	H3 (968.4, -295.3)	K4 ( -130.0, 1002.1)	B3(-1054.4, -146.5)
B7( -84.6, -1086.1)	H2 (957.6, -93.4)	K2 ( -284.5, 1002.1)	C3(-1054.4, -305.3)
C7( 74.2, -1086.1)	GND(955.4, 133.4)	VDD ( -439.0, 1002.1)	A4(-1054.4, -466.2)
A8( 231.9, -1086.1)	VC (955.4, 351.8)	APODIS( -581.6, 1002.1)	B4(-1054.4, -624.3)
B8( 393.2, -1086.1)	VA (959.3, 634.9)	H1 ( -724.9, 1001.3)	C4(-1054.4, -785.2)
C8( 552.6, -1086.1)	VB (959.3, 776.6)	A1 ( -866.9, 1002.1)	A5(-1054.4, -942.6)
A9( 711.4, -1086.1)	EXT(960.2, 934.7)	B1 ( -1008.9, 1002.1)	

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## APPLICATION DIAGRAM FOR BATTERY SUPPLY

(Note: Chip substrate must be connected to GND or left floating)



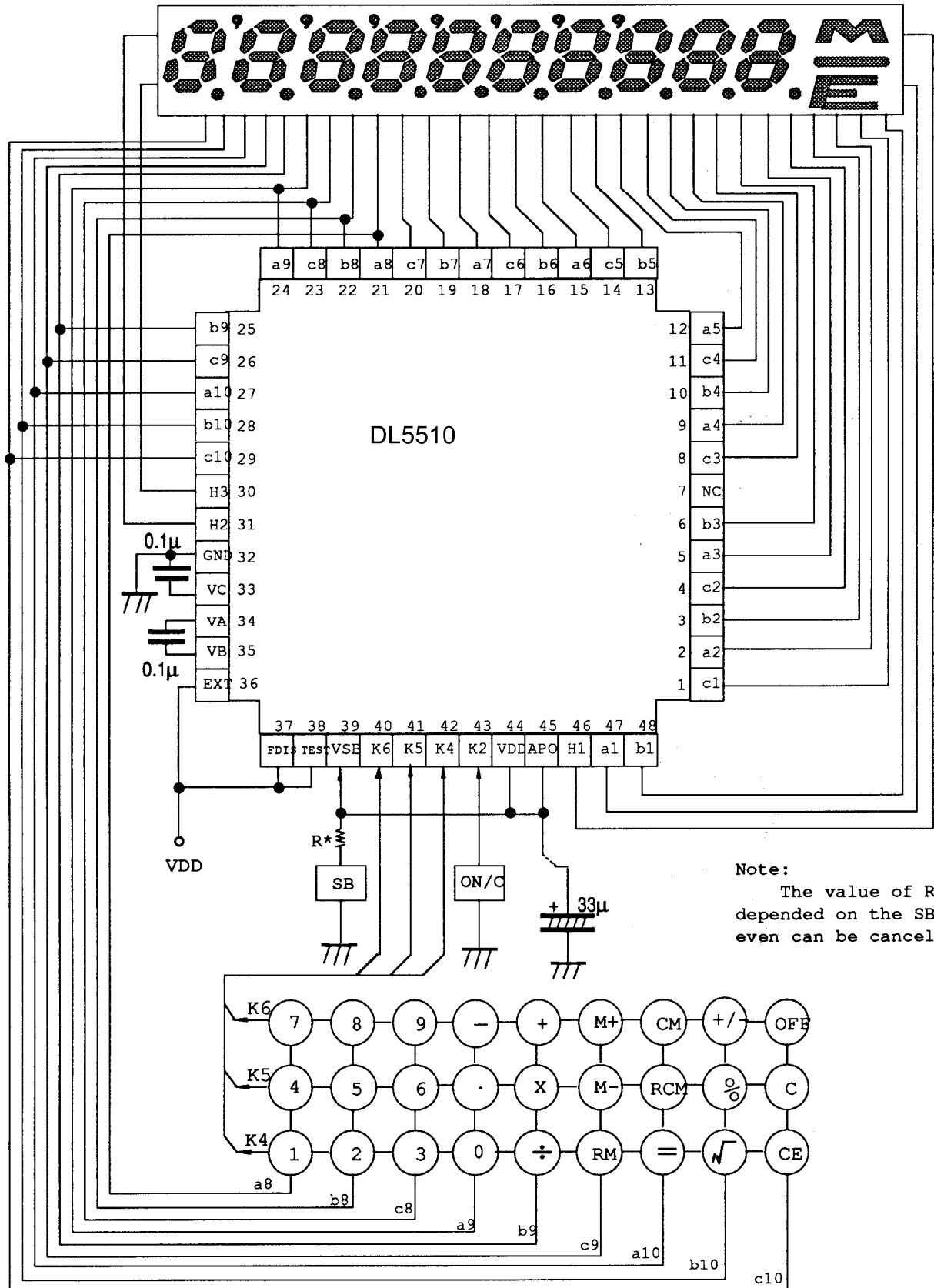


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## APPLICATION DIAGRAM FOR SOLAR CELL SUPPLY

(Note: Chip substrate must be connected to GND or left floating)



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## APPLICATION DIAGRAM For DUAL POWER SUPPLY

(Note: Chip substrate must be connected to GND or left floating)

