8 Digits Calculator With Punctuation and MU LSI

GENERAL DESCRIPTION

is a CMOS LSI calculator chip with 8 digits arithmetic operations, single memory, extraction-of-square-root, percentage and mark up calculation, auto power off, punctuation and MU function, design for FEM LCD operation with 1.5V DC power supply.

APPLICATION

DL5565 This specification contains complete information of functional operations, electrical characteristics, packaging, and crating requirements of

FUNCTIONS

- Four standard functions (+, -, x, ÷).
- Auto-constant calculations (constant : multiplicand, divisor, addend and subtrahend).
- Chain multiplication and division.
- Square and reciprocal calculations.
- Discount and add-on calculation.
- Mark-up and mark-down calculations.
- Extraction of square root.
- Percentage calculations.
- Power calculations.
- Rough estimate calculations.
- Punctuation comma display.
- Memory calculation and memory hold
- Clear key: ON/CA, ON/CCE,CCE.

FEATURES

- Single battery or solar cell supply
- Built-in oscillator
- Accumulating memory : M+, M-, RM, CM, RCM.
- Rollover capability.
- Floating decimal.
- Overflow indication: E
- Automatic power off function.
- LCD direct drive (3.0V, 1/2 bias, 1/3 duty cycle).
- 40 QFP and bare chip available

FUNCTIONAL DESCRIPTION

a. Key Description

i) "ON/CA" Power On/Clear All key :
After the device is turned off with the OFF key, pressing this key turns it on again. This key clears the device's all internal values and calculation commands including memory contents. It is also used to clear an error state.

ii) "ON/CCE" Power On Clear/Clear entry key :
After the device is turned off with the OFF key or auto-power-off feature, pressing this key turns it on again. If the memory content is not zero when it is turned off, pressing "ON/CCE" key turns it on and LCD displays '0.' with icon 'M'. In this case, pressing the key "MR", the memory content will show up on LCD.
When the device is turned on, this key operates as CCE key.

iii) "CCE"" Clear/Clear Entry key :
Pressing this key following numerical data keys, ".", "+/-", "RCM", "RM", or "$\sqrt{\ }$" key clears the data from the display.
In any other case, or if it is pressed twice consecutively, the device's all internal status except for the memory contents are cleared.
This key is also used to clear an error state.

iv) "MU" Mark-up and mark-down key :
To be used for such purposes as calculating rates of change or setting prices.

The Calculation examples of using "MU" key are given below:

a) Setting selling prices :
Pressing Y "x" X "MU" key, the result of the formula will be Y + YX/100.
Then, followed by the "MU" key again, the result of the formula will be | YX/100 |.

The selling price and profit when a profit of 16% of the wholesale price, 3,550 yen, is anticipated can be given by :
Pressing "ON/CA" key , then press 3550 "x " 16 "MU" key, the result of the Selling price will be 4118.
Then, press the "MU" key again, the result of the Profit will be 568.
Moreover, pressing Y "/" X "MU" key, the result of the formula will be Y / (1-X/100).
followed by the "MU' key, the result of the formula will be | Y / (1-X/100)-Y |.

The selling price and profit when a profit of 20% of the wholesale price, 3,648 yen, is anticipated can be given by :
Pressing "ON/CA" key , then press 3648 divided by 20 "MU", the result of the Selling price will be 4560.
Then, press the "MU" key again, the result of the Profit will be 912.

b) Rate of change :
Y "-" X "MU" = 100 (Y-X) / X
175 is how many per cent increase on 140?
"ON/CA" 175 "-" 140 "MU" 25
128 is how many per cent decrease on 160?
"ON/CA" 128"-" 160 "MU" 20 -
Y "+" X "MU" = 100 (Y+X) / X

b. 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.

: 'M' Non-zero memory indicator.

: '9' punctuation comma

c. 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 result exceed 8 digits.

d. 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.

e. Error Release

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

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

A calculation result is not cleared by ON/CCE, CCE key but is retained.

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

g. **Memory Protection**
The memory contents before any error detection are protected.

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

i. **Key bounce protection**
i) Front edge : Minimum 3 words.
ii)Trailling edge : Minimum 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.

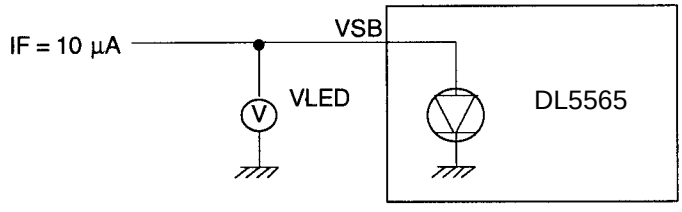
k. **Clear Operation**
All operations including memory content are cleared by ON/CA key.

ELECTRICAL CHARACTERISTICS

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Note
Display Frequency	fd	45	67	—	Hz	VGG = 1.3V	1
Current Consumption 1	I_{dis}	—	3.5	8.0	µA	V_{GG} = 1.3V during display (0.).	—
Current Consumption 2	I_{op}	—	5.0	7.0	µA	V_{GG} = 1.1V during operation.	—
Current Consumption 3	I_{off}	—	0.01	0.8	µA	Non-display state V_{GG} = 1.3V.	—
LED Current	ILDH	50	—	—	µA	VGG = 1.7V	—
	ILDL	—	—	8		VGG = 1.1V	
LED Voltage	VLED	1.46	1.53	1.6	V	IF = 10 µA, Ta = 25 °C Non-load.	2

Note 1 : a6 ~ a8, b6 ~ b8, c6 ~ c8.
Note 2 :



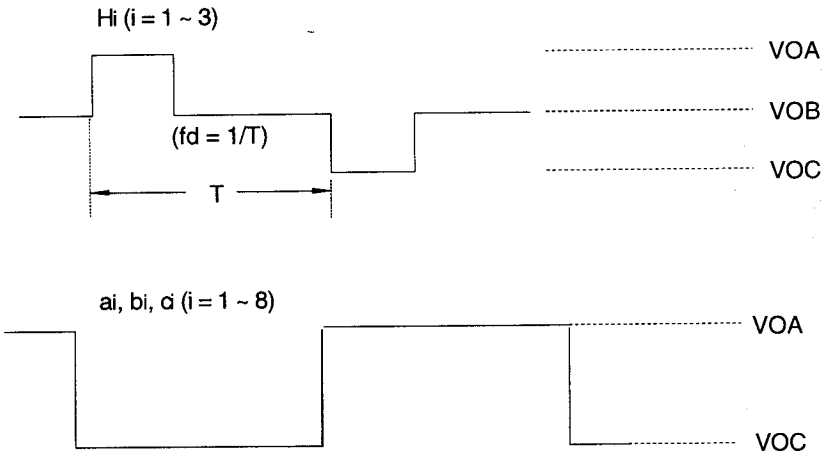
ABSOLUTE MAXIMUM RATINGS

Parameters	Symbol	Value	Unit	Note
Pin voltage 1	Vt1	- 0.3 ~ + 2.0	V	1
Pin voltage 2	Vt2	- 0.3 ~ VGG + 0.3	V	2
Supply Voltage	VGG	1.3 ~ 1.7	V	—
Operating temperature	Topr	0 ~ + 50	°C	—

Note 1 : Maximum voltage applied to VGG pin with reference to the GND pin.

Note 2 : Maximum voltage applied to any pin other than VGG with reference to the GND pin.

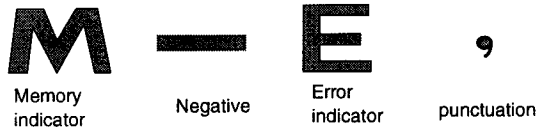
LCD BACKPLANE OUTPUT WAVEFORM



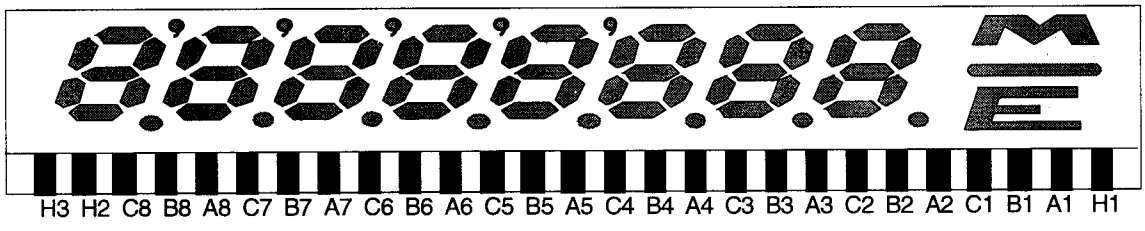
DISPLAY FONTS

a. **Numerical Font**

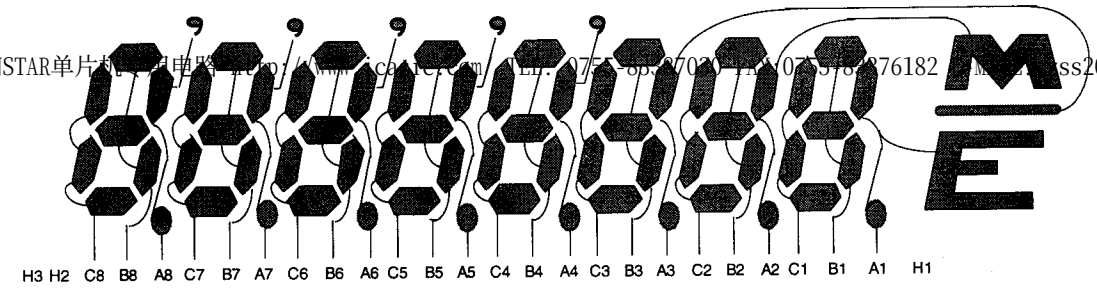
b. **Sign Font**



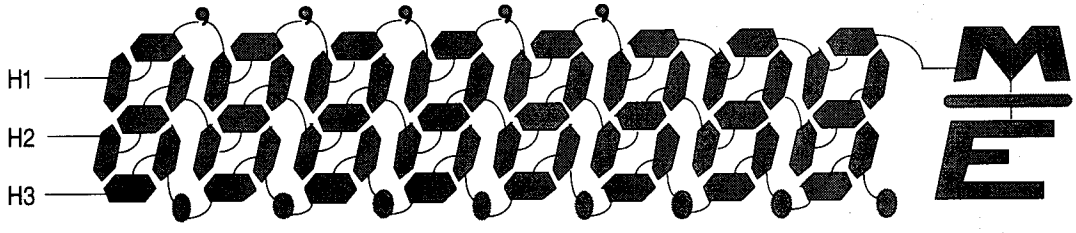
LCD CONNECTOR



LCD Panel



Segment Connection



Common Connection

MARK-UP AND MARK-DOWN CALCULATION

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

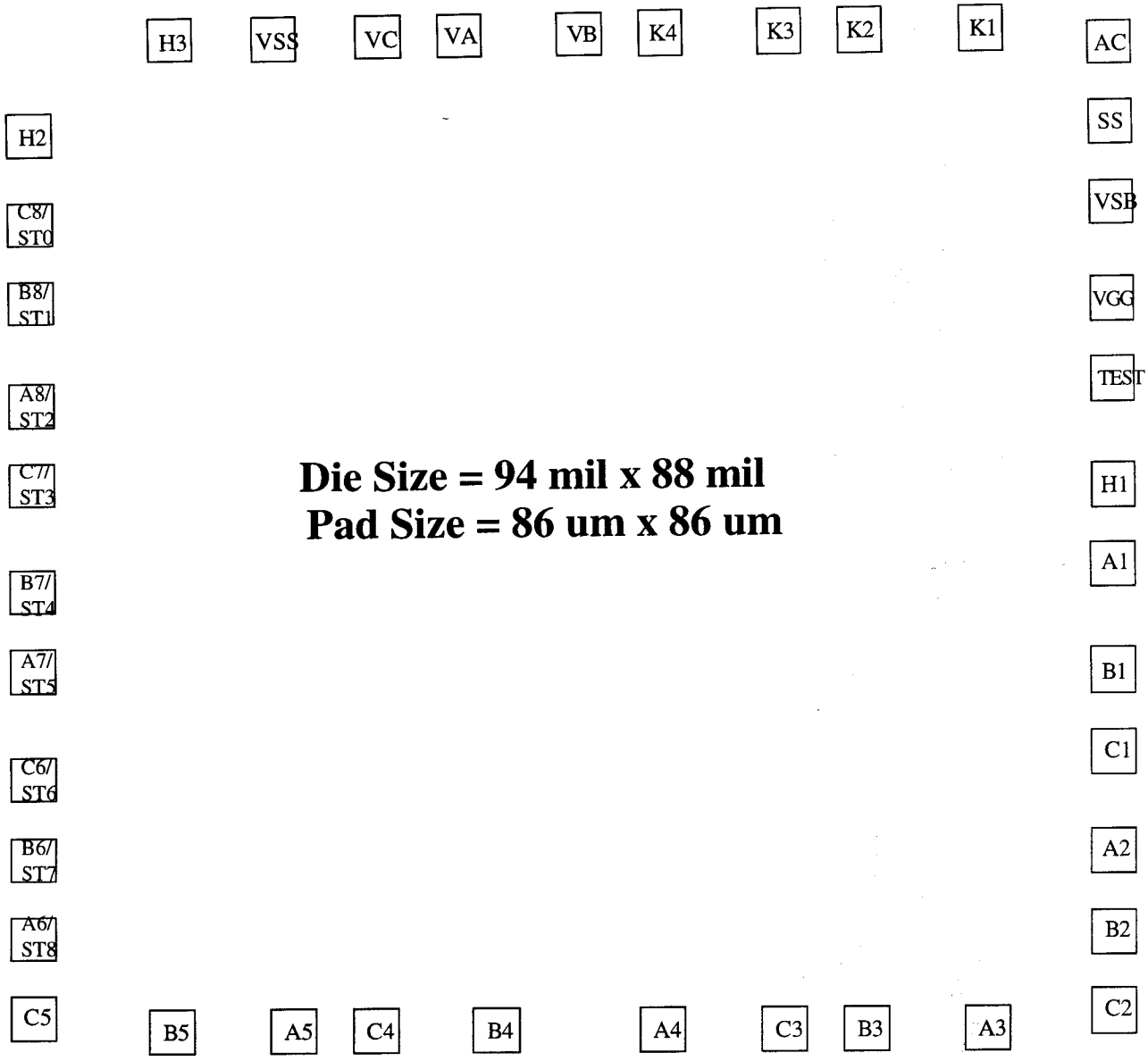
ENTRY		DISPLAY	
A	A	A	A
+ OR -	X	A	A
B	B	B	B
%	%	A+AM/100 OR A-AM/100	*AM/100
	+ OR -		AM/100
	=		A+AM/100 OR A-AM/100

* AM : AMOUNT

PIN DESCRIPTION

Pin No.	Signal	I/O	Description
1	C2	O	Segment Output
2	B2	O	Segment Output
3	A2	O	Segment Output
4	C1	O	Segment Output
5	B1	O	Segment Output
6	A1	O	Segment Output
7	H1	O	Common Output
8	TEST	I	TEST Input
9	VGG	-	Power Supply Pin
10	VSB	-	Solar Cell Supply Pin
11	SS	I	APO/MH Select
12	AC	I	ACL Input
13	K1	I	Key Input
14	K2	I	Key Input
15	K3	I	Key Input
16	K4	I	Key Input
17	VB	O	Voltage Boosting Capacitor Pin
18	VA	O	Voltage Boosting Capacitor Pin
19	VC	O	Voltage Boosting Capacitor Pin
20	Vss	-	Power Supply

Pin No.	Signal	I/O	Description
21	H3	O	Common Output
22	H2	O	Common Output
23	C8/ST0	O	Segment and Key Strobe Output
24	B8/ST1	O	Segment and Key Strobe Output
25	A8/ST2	O	Segment and Key Strobe Output
26	C7/ST3	O	Segment and Key Strobe Output
27	B7/ST4	O	Segment and Key Strobe Output
28	A7/ST5	O	Segment and Key Strobe Output
29	C6/ST6	O	Segme nt and Key Strobe Output
30	B6/ST7	O	Segment and Key Strobe Output
31	A6/ST8	O	Segment and Key Strobe Output
32	C5	O	Segment Output
33	B5	O	Segment Output
34	A5	O	Segment Output
35	C4	O	Segment Output
36	B4	O	Segment Output
37	A4	O	Segment Output
38	C3	O	Segment Output
39	B3	O	Segment Output
40	A3	O	Segment Output



Die Size = 94 mil x 88 mil
Pad Size = 86 um x 86 um

The Co-ordinate For Low Left Corner of Each Pad

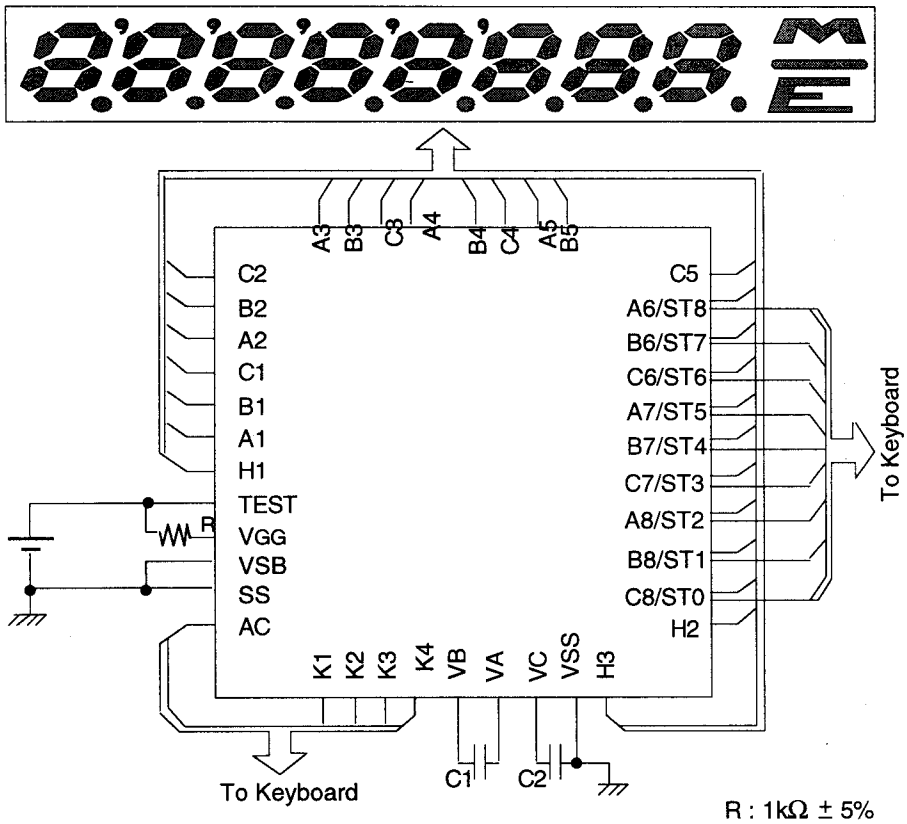
B5 (-833.8, -1027.2)
A5(-595.8, -1027.2)
C4(-437.9, -1027.2)
B4(-200.8, -1027.2)
A4(124.0, -1027.2)
C3(364.0, -1027.2)
B3(521.9, -1027.2)
A3(760.7, -1027.2)

C2 (1009.7, -996.2)
B2 (1009.7, -839.8)
A2 (1009.7, -681.9)
C1 (1009.7, -487.0)
B1 (1009.7, -329.1)
A1 (1009.7, -118.7)
H1 (1009.7, 39.2)
TEST(1009.7, 246.4)
VGG (1009.7, 404.3)
VSB (1009.7, 595.5)
SS (1009.7, 753.4)
AC (1009.7, 909.8)

K1 (757.9, 941.1)
K2 (522.8, 941.1)
K3 (364.9, 941.1)
K4 (130.8, 941.1)
VB (-27.1, 941.1)
VA (-263.0, 941.1)
VC (-420.9, 941.1)
VSS(-623.6, 939.4)
H3 (-826.1, 941.1)

H2 (-1104.8, 755.6)
C8/ST0(-1104.8, 579.7)
B8/ST1(-1104.8, 421.8)
A8/ST2(-1104.8, 218.0)
C7/ST3(-1104.8, 60.1)
B7/ST4(-1104.8, -153.4)
A7/ST5(-1104.8, -311.3)
C6/ST6(-1104.8, -526.4)
B6/ST7 (-1104.8, -684.3)
A6/ST8(-1104.8, -842.6)
C5 (-1104.8, -1000.5)

APPLICATION DIAGRAM (BATTERY OPERATION)



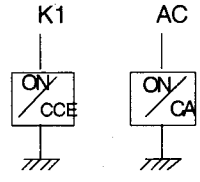
R : 1kΩ ± 5%

C1, C2 : 0.1 μF

Keyboard

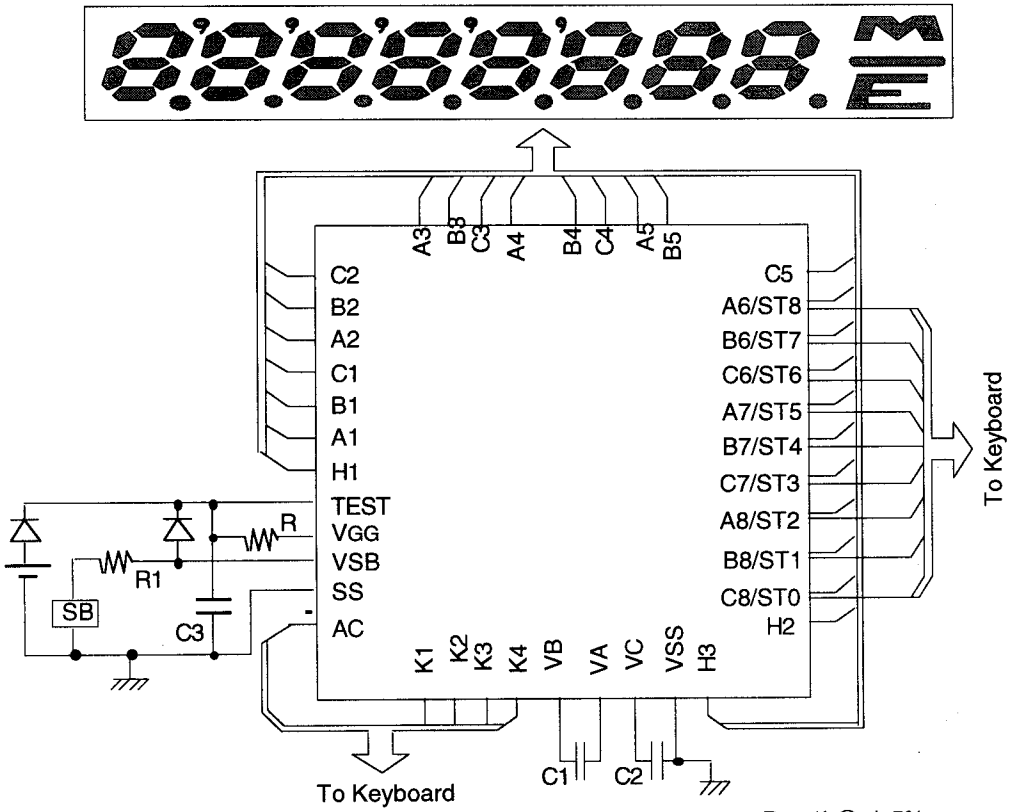
	ST8 A6	ST7 B6	ST6 C6	ST5 A7	ST4 B7	ST3 C7	ST2 A8	ST1 B8	ST0 C8
K4	7	8	9	−	+	M+	CM	+/-	OFF
K3	4	5	6	·	X	M-	RCM	%	CCE
K2	1	2	3	0	÷	RM	=	√	MU

The TEST pin should be pulled up to VGG



Note: Substrate should be connected to VSS

APPLICATION DIAGRAM (DUAL POWER OPERATION)

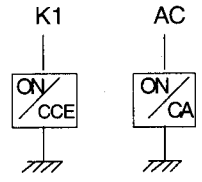


R : 1kΩ ± 5%
R1 : 10kΩ ± 5%
C1, C2 : 0.1 µF
C3 : 10 µF
SB : Solar Battery

Keyboard

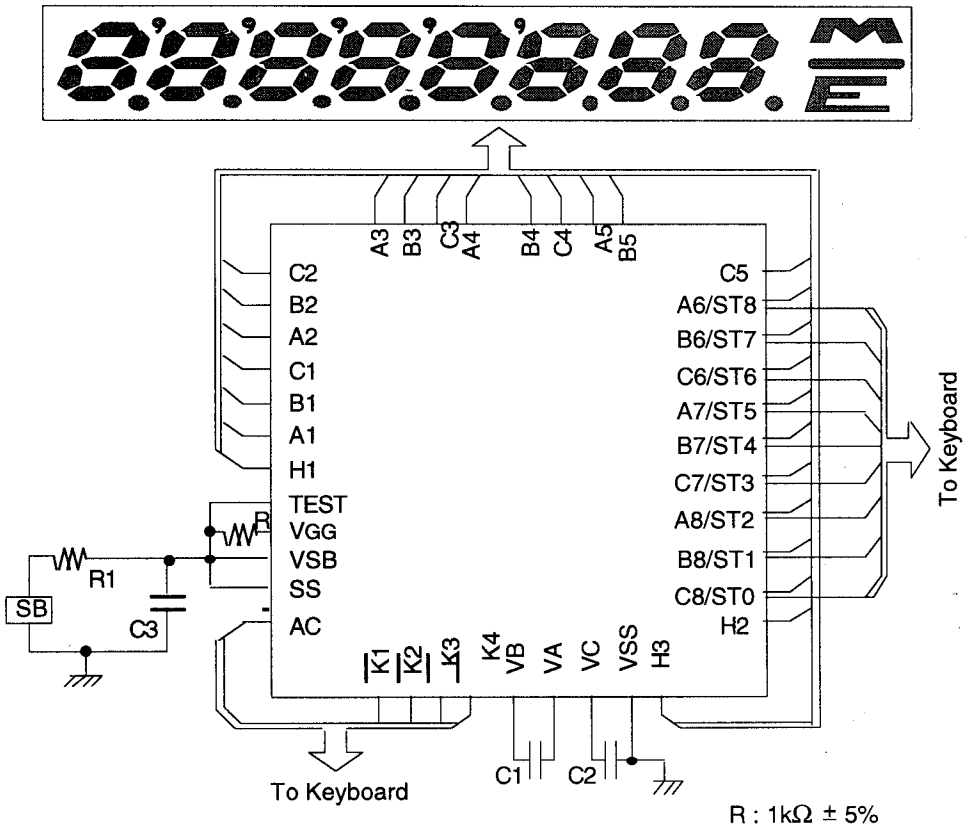
	ST8 A6	ST7 B6	ST6 C6	ST5 A7	ST4 B7	ST3 C7	ST2 A8	ST1 B8	ST0 C8
K4	7	8	9	−	+	M+	CM	+/-	OFF
K3	4	5	6	·	X	M-	RCM	%	CCE
K2	1	2	3	0	÷	RM	=	√	MU

The TEST pin should be pulled up to VGG



Note: Substrate should be connected to VSS

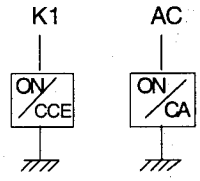
APPLICATION DIAGRAM (SOLAR CELL OPERATION)



R : 1kΩ ± 5%
R1 : 10kΩ ± 5%
C1, C2 : 0.1 µF
C3 : 10 µF
SB : Solar Battery

Keyboard

	ST8 A6	ST7 B6	ST6 C6	ST5 A7	ST4 B7	ST3 C7	ST2 A8	ST1 B8	ST0 C8
K4	7	8	9	−	+	M+	CM	+/-	OFF
K3	4	5	6	·	X	M-	RCM	%	CCE
K2	1	2	3	0	÷	RM	=	√	MU



Note: Substrate should be connected to VSS