RCL Semiconductors Ltd.

10-Digit LCD Calculator With Punctuation And Touch Tone

C9689

GENERAL DESCRIPTION

C9689 is a CMOS LSI calculator chip with 10 digits arithmetic operations, single memory, extraction-of-square-root percentage calculation, auto power off, punctuation and touch tone function, designed for FEM LCD operation with a 1.5 V power supply.

APPLICATION

This specification contains complete information of functional operations, electrical characteristics, packaging, and crating requirements of C9689.

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.
- Sign reversal (+/-).
- Rough estimate calculations.
- Punctuation comma and touch tone mark display.
- Clear key: ON/C, C,CE.
- Touch tone function.

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.
- 1.5v power supply.
- Very low power consumption.
- 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' Memory indicator.

: '9' Punctuation comma.

: '♪' Touch tone indicator

b. **Error Detections**

i) System errors occur when :

- The integral part of any memory calculation result exceeds 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, reciproca 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 if 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 key.

ii)ON/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**

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

f. **Memory Protection**

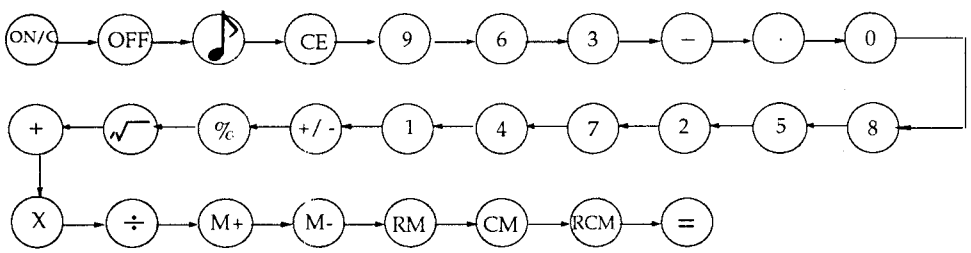
In any error detection, the memory content is retained.

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)Trailling edge : Minimum 16 words. (1 word is 3.3ms when display frequency is Fd=100Hz.)

j. **Auto Power Off**

Power automatically turns off after 7-8 minutes pass from the last key pressed. By connecting the APODIS pin to GND or V_{GG}, the auto power off function is disabled or enabled, respectively.

k. **Clear Operation**

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

l. **CE Key**

CE key can edit the last operand or operator.

ABSOLUTE MAXIMUM RATINGS

Parameters	Symbol	Value	Unit	Note
Supply Voltage	VGG	1.1~ 1.8	V	1
Input Voltage	VIN	- 0.3 ~ VGG + 0.3	V	2
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.

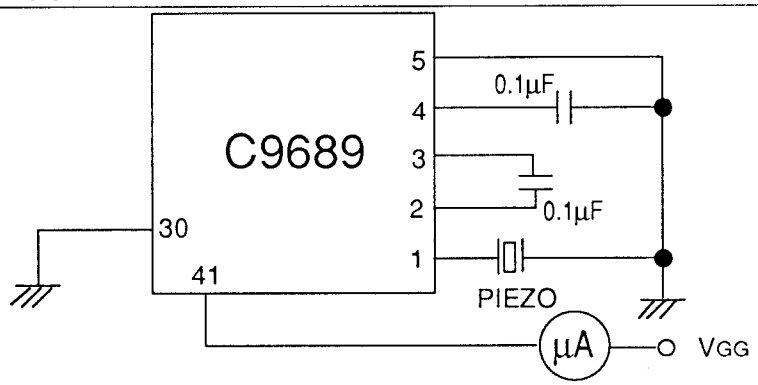
Note 2 : Maxcium voltage on input pin with respect to the GND.

ELECTRICAL CHARACTERISTICS

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

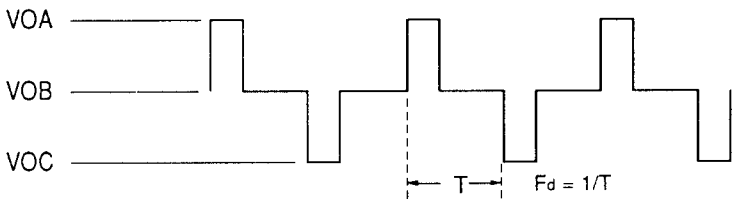
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Note
Operating voltage	VOP	1.1	1.5	1.8	V	--	
Input Voltage	VIH	VGG-0.4	--	--	V	--	3
	VIL	--	--	0.4		--	
Input Current 1	IIH1	--	--	1	µA	Vin=VGG	3
	IIL1	1.5	2.5	3		Vin=0V	
Input Current 2	IIH2	--	--	1	µA	APODISB=0V, FDISB=0V Vin=Vcc(3v)	4
	IIL2	3	5.5	7.5		APODISB=0V, FDISB=0V Vin = OV	
Output Voltage	VOA	2.80	2.95	--	V	No load	5
	VOB	1.30	1.50	1.70		No load	
	VOC	--	0	0.20		No load	
TouchTone Output Drive Current	IOH	1.3	2	--	mA	VGG = 1.5V, VOH = 1.0V, APODISB, FDISB=0V	6
	IOL	1.3	2	--	mA	VGG = 1.5V, VOL = 0.5V, APODISB, FDISB=1.5V	
Display Frequency	Fd	40	65	75	Hz	VGG =1.3V, while display is ON.	--
Dissipation	IOFF	--	--	0.1	µA	Display is OFF	7
	IDIS	--	6	10		VGG = 1.3V, Display On	8

Note 3 : Applies to Pins FDISB, EXT.
Note 4 : Applies to Pins K4 ~ K6 .
Note 5 : Applies to a1~a11, b1 ~ b10 ,c1~c10, H1~H3.
Note 6 : Applies to PO.
Note 7 : Measured by the bellow test circuit after power supply automatically turns off.
Note 8 : Measured by the bellow test circuit while "0" is being displayed after auto-clear operation and while no key is being depressed.

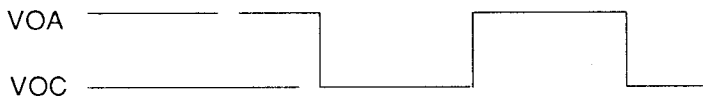


TEST CIRCUIT

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

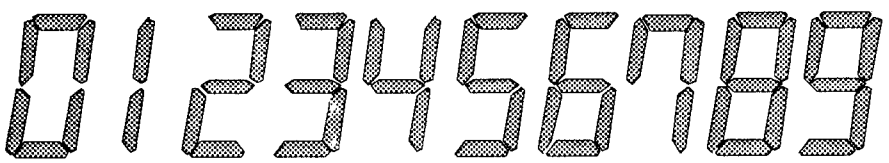


LCD BACKPLANE OUTPUT WAVEFORM 2; ai, bi, ci (i=1,2, - - - 10)

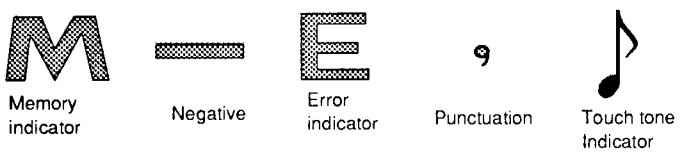


DISPLAY FONTS

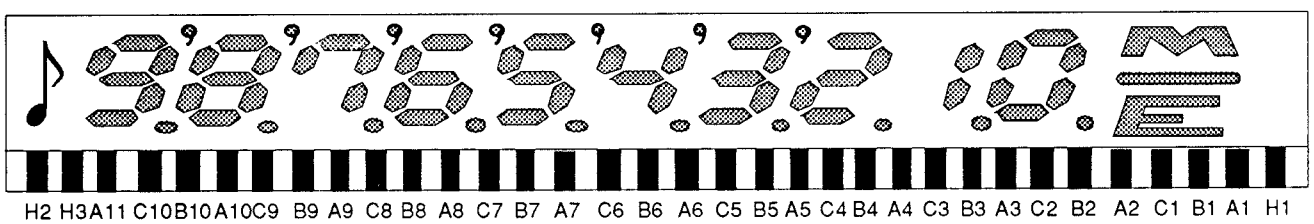
a. **Numerical Font**



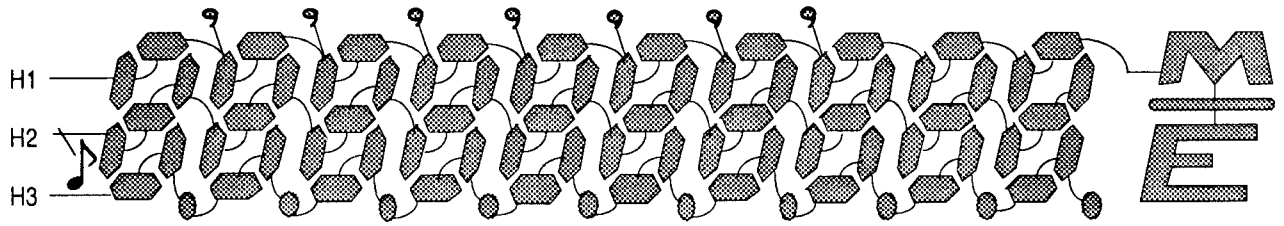
b. **Sign Font**



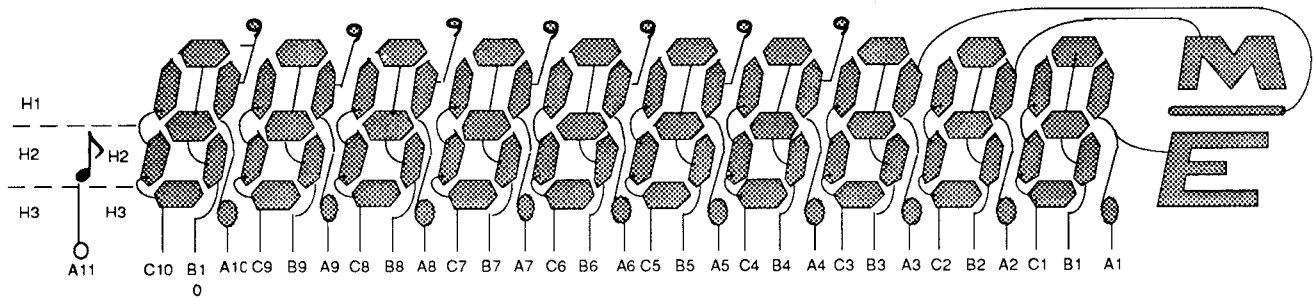
LCD CONNECTOR



LCD Panel



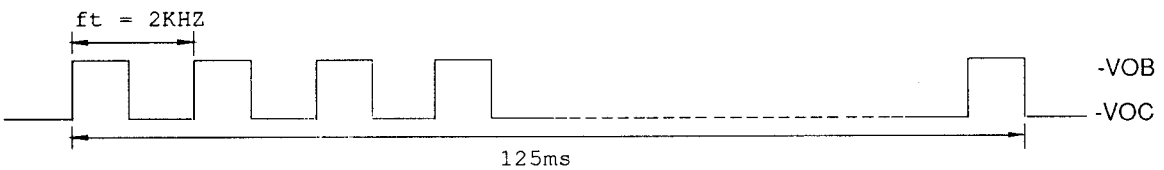
Backplanes Connection



Segment Connection

TOUCH TONE (♪) KEY

a. When power is ON, the touch tone function is enable and the beep sound is generated output during 125ms and ♪ sign is displayed on LCD.
b. Selection of touch tone function is toggled by touch tone key.
c. Output wave form.



MARK-UP AND MARK-DOWN CALCULATION

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

ENTRY		DISPLAY	
A	A	A	A
+/-	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

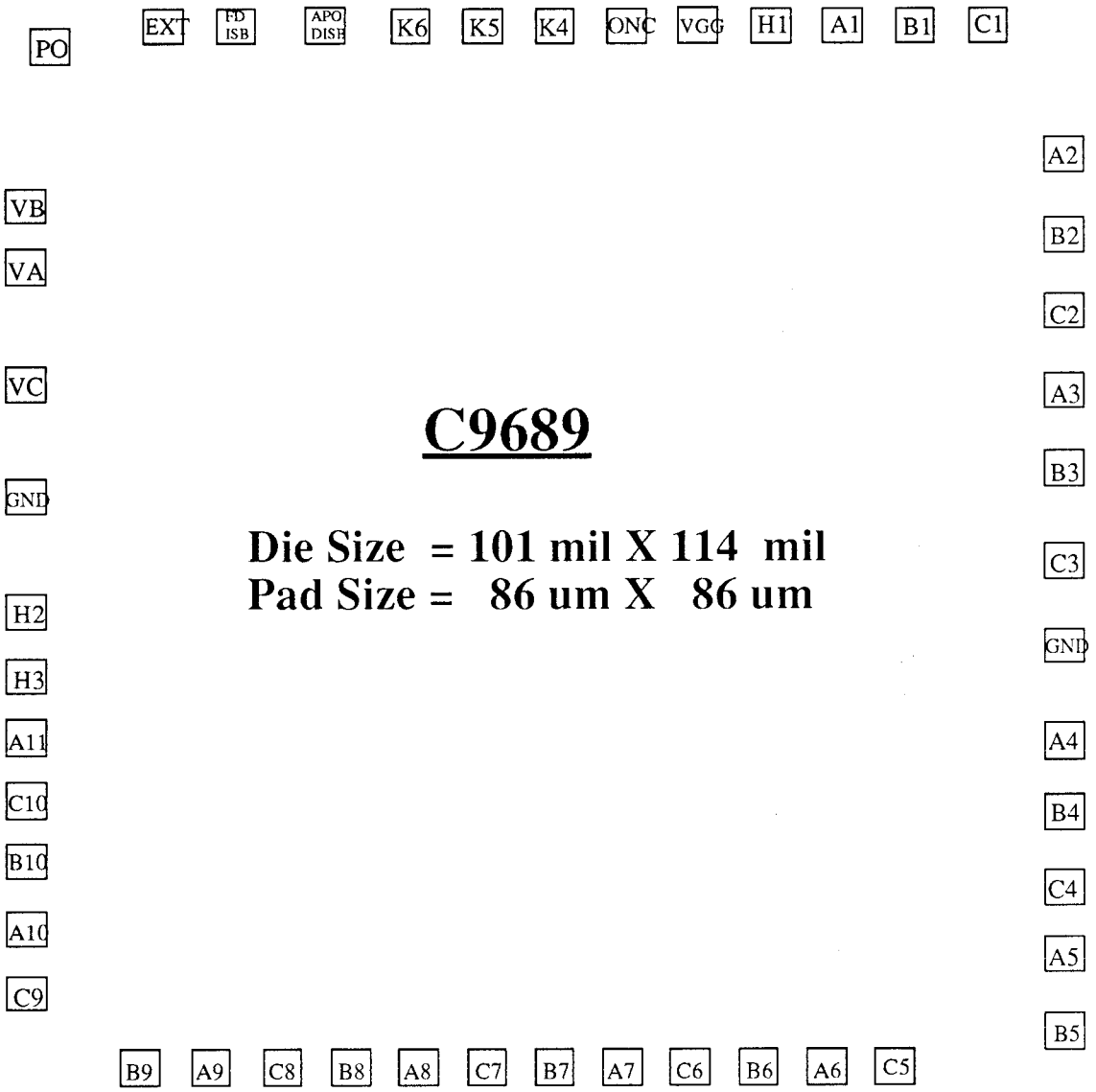
PIN DESCRIPTIOON

Pin No.	Signal	I/O	Description
1	PO	O	Piezo Output.
2	VB	O	Capacitor Terminal
3	VA	O	Capacitor Terminal
4	VC	O	Capacitor Terminal
5	GND	-	Ground
6	H2	O	COMMON 2
7	H3	O	COMMON 3
8	a11	O	Display output
9	c10	O	Display output / Strobe 9
10	b10	O	Display output / Strobe 8
11	a10	O	Display output / Strobe 7
12	c9	O	Display output / Strobe 6
13	b9	O	Display output / Strobe 5
14	a9	O	Display output / Strobe 4
15	c8	O	Display output / Strobe 3
16	b8	O	Display output / Strobe 2
17	a8	O	Display output / Strobe 1
18	c7	O	Display output
19	b7	O	Display output
20	a7	O	Display output
21	c6	O	Display output
22	b6	O	Display output
23	a6	O	Display output
24	c5	O	Display output

Pin No.	Signal	I/O	Description
25	b5	O	Display output
26	a5	O	Display output
27	c4	O	Display output
28	b4	O	Display output
29	a4	O	Display output
30	NC	-	No Connection
31	c3	O	Display output
32	b3	O	Display output
33	a3	O	Display output
34	c2	O	Display output
35	b2	O	Display output
36	a2	O	Display output
37	c1	O	Display output
38	b1	O	Display output
39	a1	O	Display output
40	H1	O	COMMON 1
41	VGG	-	Power Supply
42	ONC	I	Key input
43	K4	I	Key input
44	K5	I	Key input
45	K6	I	Key input
46	APO-DISB	I	APO Disable
47	FDISB	I	Fosc Disable
48	EXT	I	External Clock

*APO : Auto Power Off

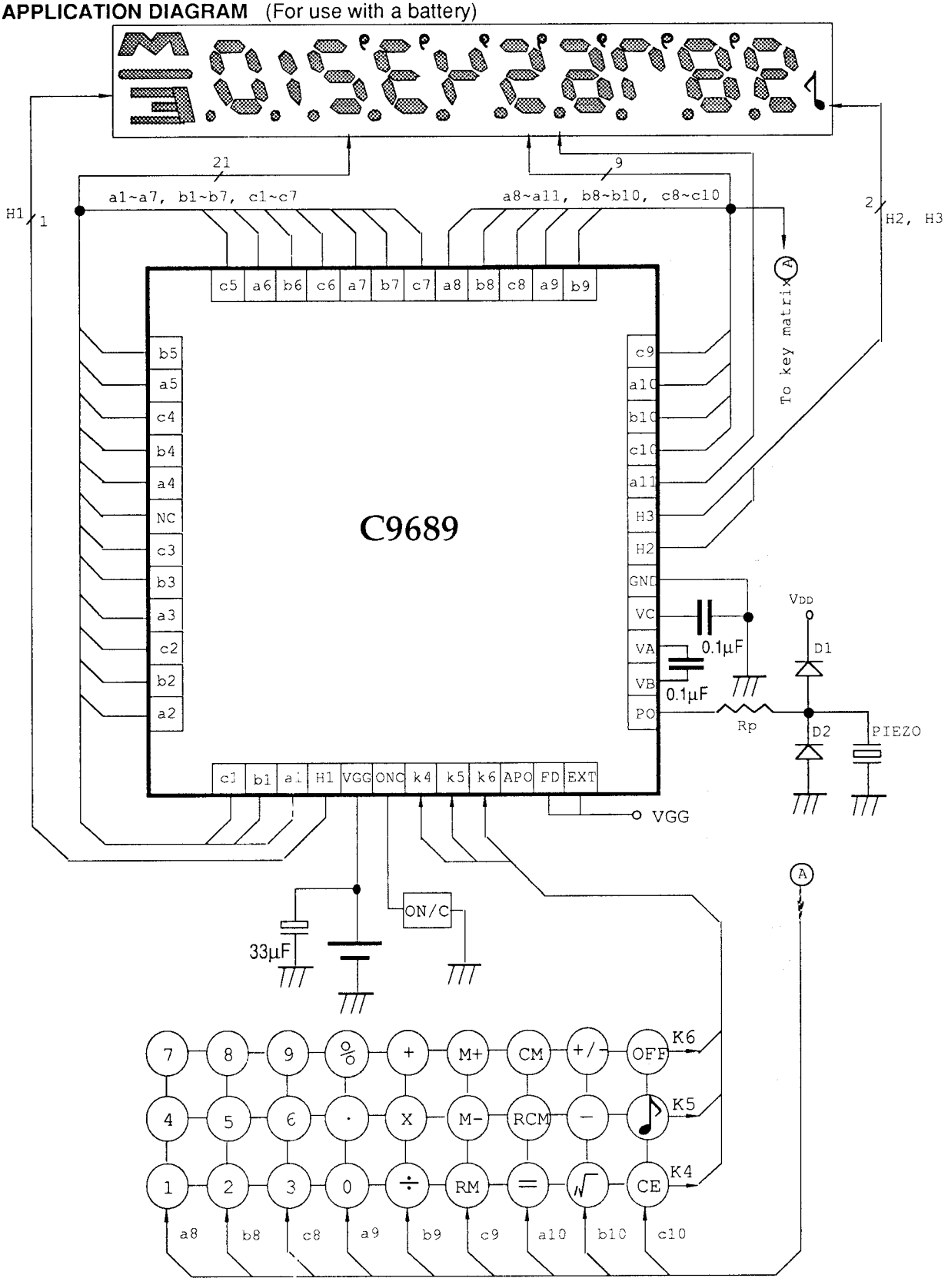
C9689 PAD DIAGRAM



The Co-ordinate for Low Left Corner of Each Pad

B9 (-943.7, -1318.3)	B5 (1109.1, -1235.5)	C1 (940.1, 1231.7)	PO (-1140.0, 1183.0)
A9 (-788.7, -1318.3)	A5 (1109.1, -1045.7)	B1 (777.7, 1231.7)	VB (-1195.2, 789.2)
C8 (-629.7, -1318.3)	C4 (1109.1, -878.2)	A1 (617.7, 1231.7)	VA (-1195.2, 639.0)
B8 (-478.7, -1318.3)	B4 (1109.1, -695.7)	H1 (457.7, 1231.8)	VC (-1195.2, 349.3)
A8 (-327.7, -1318.3)	A4 (1109.1, -525.3)	VGG (297.2, 1232.3)	GND (-1195.2, 78.2)
C7 (-176.7, -1318.3)	GND (1109.1, -293.3)	ONC (137.2, 1231.7)	H2 (-1195.2, -203.7)
B7 (- 25.7, -1318.3)	C3 (1109.1, -81.8)	K4 (- 22.8, 1231.6)	H3 (-1195.2, -363.7)
A7 (125.3, -1318.3)	B3 (1109.3, 142.8)	K5 (-182.8, 1231.6)	A11 (-1195.2, -510.4)
C6 (276.3, -1318.3)	A3 (1109.0, 332.3)	K6 (-342.8, 1231.6)	C10 (-1195.2, -662.1)
B6 (427.3, -1318.3)	C2 (1109.1, 527.9)	APO DISB (-533.1, 1232.4)	B10 (-1195.2, -809.1)
A6 (578.2, -1318.3)	B2 (1109.1, 713.6)	FDISB (-730.0, 1230.5)	A10 (-1195.1, -977.0)
C5 (729.3, -1318.3)	A2 (1108.8, 911.6)	EXT (-890.0, 1230.6)	C9 (-1195.1, -1138.8)

APPLICATION DIAGRAM (For use with a battery)



NOTE :
1. D1, D2 : protection Diode
2. Rp : protection Resistor (0.5 ~ 1.5K)