Touch Tone Calculator LSI

C9389E

GENERAL DESCRIPTION

C9389E is a CMOS LSI calculator chip with 8 digits arithmetic operations, single memory, extraction-of-square-root percentage calculation, auto power off and punctuation and touch tone function, design for FEM LCD operation with 3.0 V power supply.

APPLICATION

This specification contains complete information of functional operations, electrical characteristics, packaging, and crating requirements of C9389E.

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.
- Touch tone function.
- Punctuation comma display.
- Clear key: ON/C, ON/CE,CE.

FEATURES

- Accumulating memory : M+, M-, RM, CM, RM/CM.
- Rollover capability.
- Floating decimal.
- Overflow indication: E
- Automatic power off function.
- LCD direct drive.
- 48 QFP and bare chip available

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.

: 'M' Non-zero memory indicator.

: '9' punctuation comma

: '♪' touch tone 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 result exceed 8 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 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.

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

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

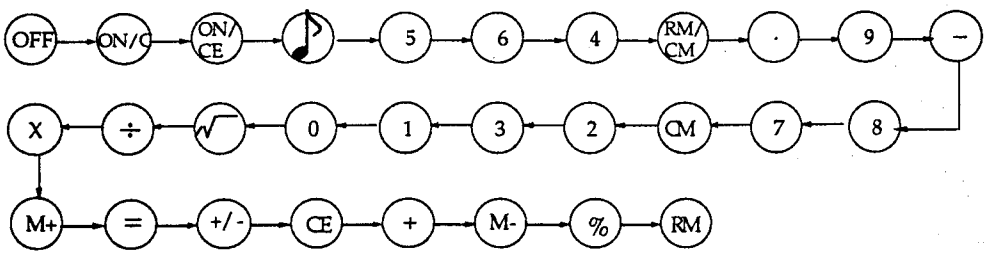
The memory contents before any error detection are protected.

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 : 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

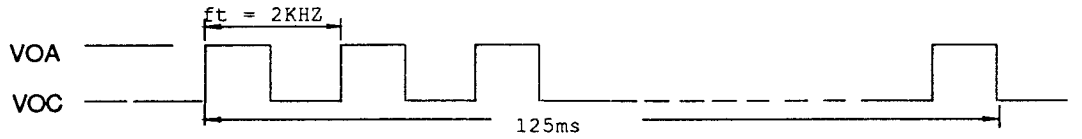
All operations except memory content are cleared by ON/C key.

l. Touch Tone(♪) Key

i) When power is on, the touch tone function is enable and the beep sound is generated output during 125 ms and ♪ sign is displayed on LCD.

ii) Selection of touch tone function is toggled by touch tone key.

iii) Output waveform



ABSOLUTE MAXIMUM RATINGS

Parameters	Symbol	Value	Unit	Note
Terminal voltage	V_{DD}	- 0.3 ~ + 3.5	V	1
	V_{IN}	- 0.3 ~ V_{DD} + 0.3	V	1
Supply Voltage	V_{DD}	2.5 ~ 3.5	V	—
Operating temperature range	T_{OPR}	0 ~ + 50	°C	—
Storage temperature range	T_{STG}	- 55 ~ + 125	°C	—

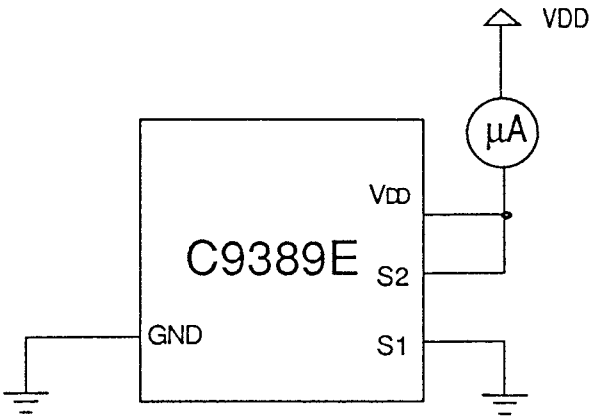
Note 1 : Maximum voltage on any pin is referenced to GND.

ELECTRICAL CHARACTERISTICS

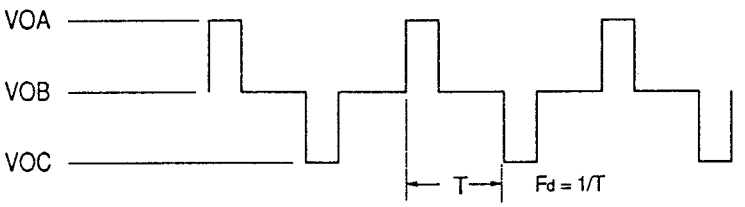
(Ta = 25°C, V_{DD} = 3V unless otherwise specified)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Condition	Note
Input Voltage 1	V_{IH1}	V_{DD}-0.4	—	—	V	—	2
	V_{IL1}	—	—	0.4		—	
Input Current 1	I_{IH1}	—	—	1	uA	Vin = V_{DD}	3
	I_{IL1}	—	5.5	10		Vin = 0V	
Output Voltage 1	V_{OH1}	V_{DD}-0.15	—	—	V	No load	4
	V_{OL1}	—	—	0.15		I_{OUT} = 15μA	
Output Voltage 2	V_{OA}	2.80	2.95	—	V	No load	5
	V_{OB}	1.30	1.50	1.70		No load	
	V_{OC}	—	0	0.20		No load	
Display Frequency	Fd	50	75	—	Hz	V_{DD} = 3V while display is ON.	5
Dissipation Current	I_{OFF}	—	—	0.1	μA	Display is OFF	6
	I_{DIS}	—	20	30		V_{DD} = 3V while display is ON.	7
Touch Tone Output Drive Current	I_{OL}	1.0	1.5	—	MA	VDD = 3V V_{OL} = 0.5V TI = 3V	8
	I_{OH}	1.0	1.3	—		VDD = 3V V_{OH} = 2.5V TI = 0V	

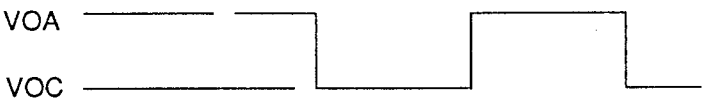
Note 2 : Applies to Pins K2 ~ K6, TI.
Note 3 : Applies to Pins K2 ~ K6 and TI.
Note 4 : Applies to P1, P2, A2 ~ A5.
Note 5 : Applies to Pins H1 ~ H3, a1 ~ a9, b1 ~ b8, c1 ~ c8.
Note 6 : Miasured by the next test circuit after power supply automatically turns off.
Note 7 : Miasured by the next test circuit while "0" is being displayed after auto-clear operation and while key is not being depressed.
Note 8 : Applies to PO



LCD BACKPLANE OUTPUT WAVEFORM 1; HI



LCD BACKPLANE OUTPUT WAVEFORM 2; ai, bi, ci

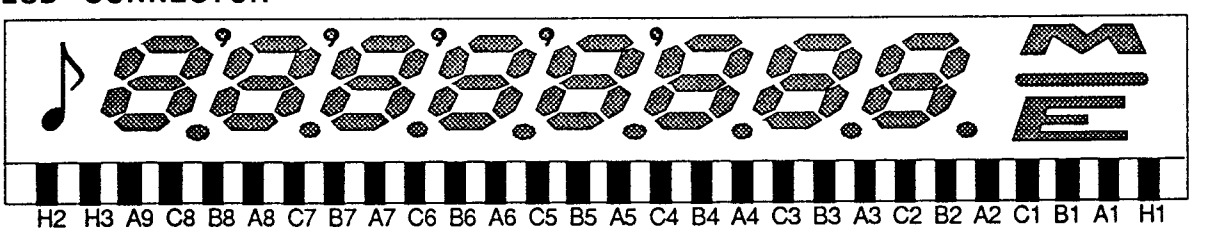


DISPLAY FONTS

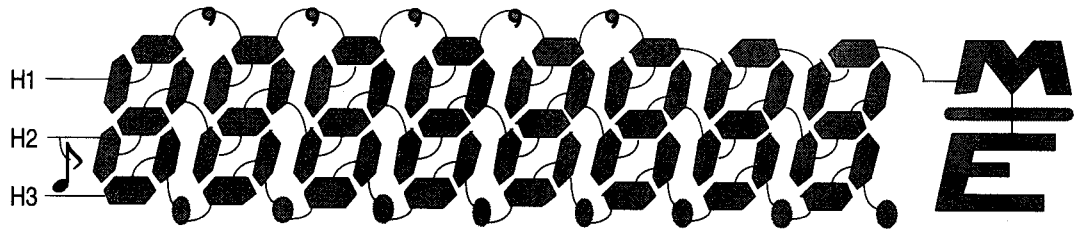
a. Numerical Font

b. Sign Font

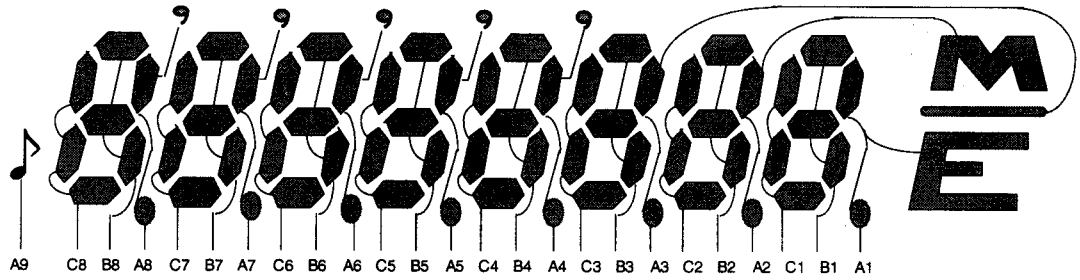
LCD CONNECTOR



LCD Panel



Backplanes Connection



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

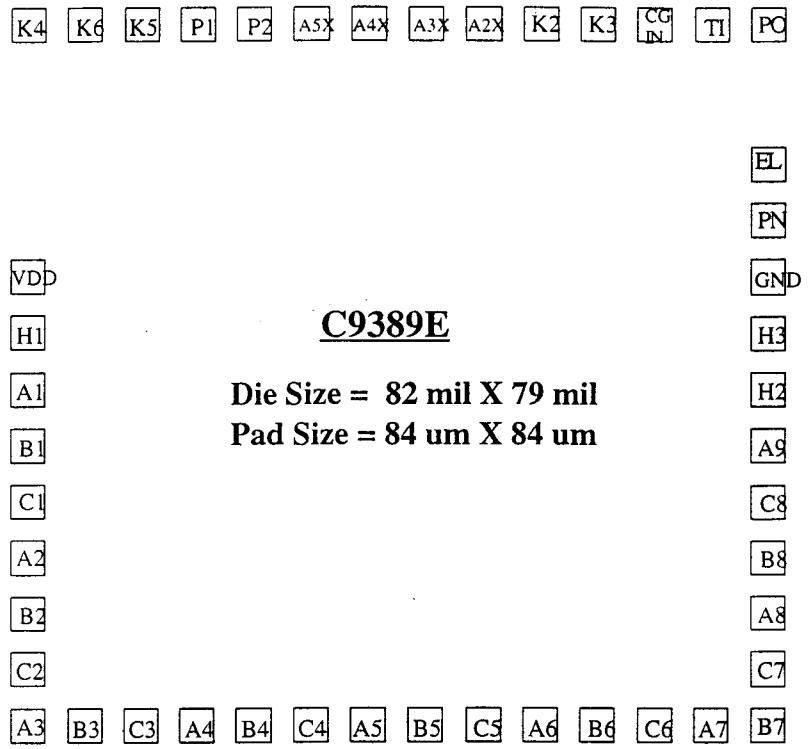
PIN DESCRIPTION

Pin No.	Signal	I/O	Description
1	VDD	-	Power supply.
2	H1	O	Display output.
3	A1	O	Display output.
4	B1	O	Display output.
5	C1	O	Display output.
6	A2	O	Display output.
7	B2	O	Display output.
8	C2	O	Display output.
9	A3	O	Display output.
10	B3	O	Display output.
11	C3	O	Display output.
12	A4	O	Display output.
13	B4	O	Display output.
14	C4	O	Display output.
15	A5	O	Display output.
16	B5	O	Display output.
17	C5	O	Display output.
18	A6	O	Display output.
19	B6	O	Display output.
20	C6	O	Display output.
21	A7	O	Display output.
22	B7	O	Display output.
23	C7	O	Display output.

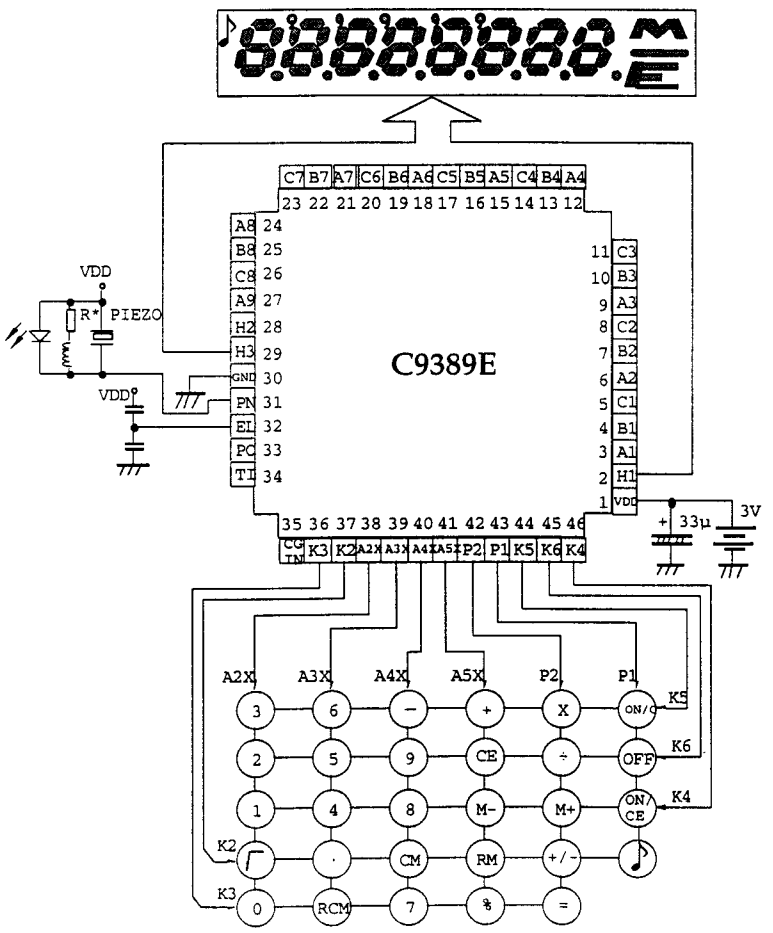
Pin No.	Signal	I/O	Description
24	A8	O	Display output.
25	B8	O	Display output.
26	C8	O	Display output.
27	A9	O	Display output.
28	H2	O	Display output.
29	H3	O	Display output.
30	GND	-	Ground.
31	PN	O	Piezo output with transistor.
32	EL		
33	PO	O	Piezo output.
34	TI	I	Test input.
35	CGIN	I	Input terminal for CG.
36	K3	I	Key input
37	K2	I	Key input.
38	A2X	O	Strobe output
39	A3X	O	Strobe output.
40	A4X	O	Strobe output.
41	A5X	O	Strobe output.
42	P2	O	Strobe output.
43	P1	O	Strobe output.
44	K5	I	Key input.
45	K6	I	Key input.
46	K4	I	Key input.

*APO : Auto Power Off

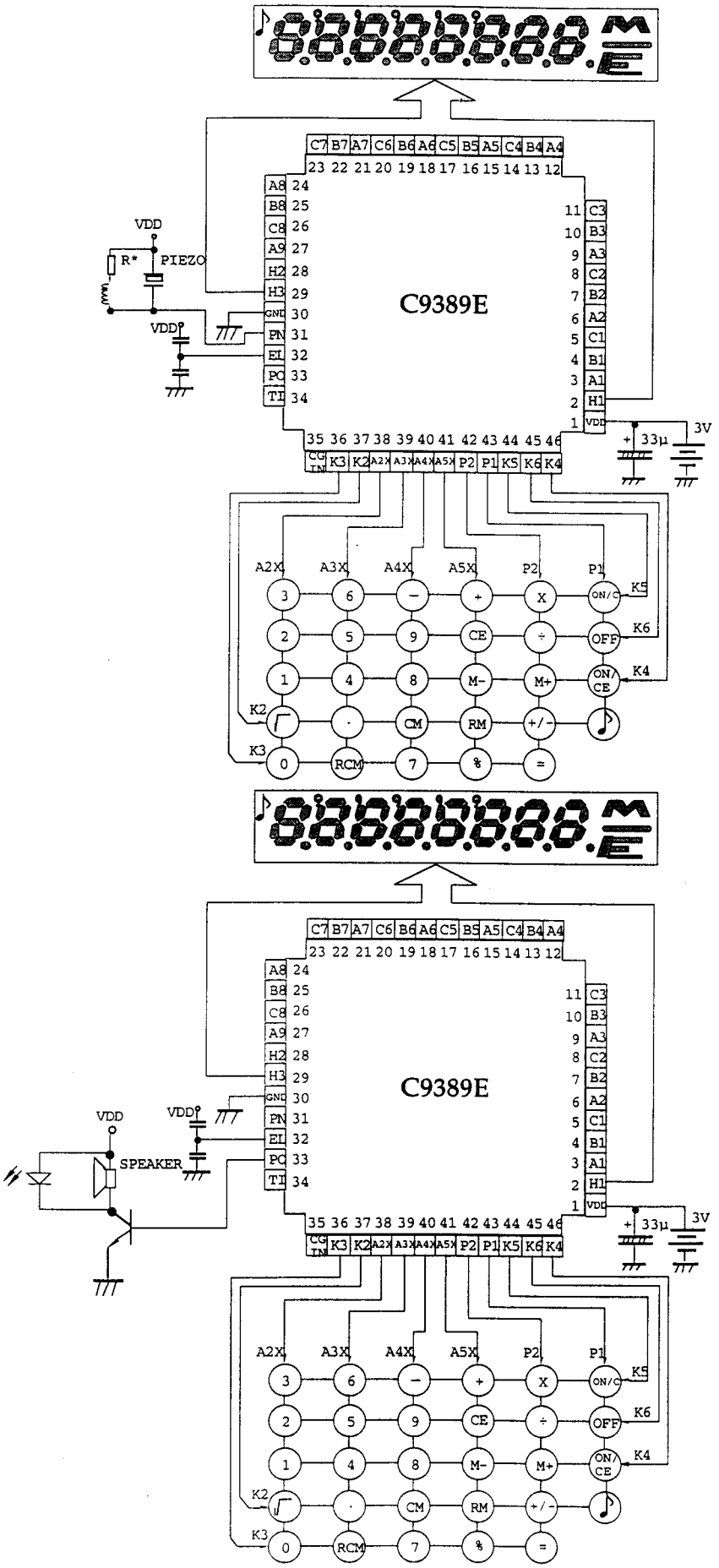
PAD DIAGRAM

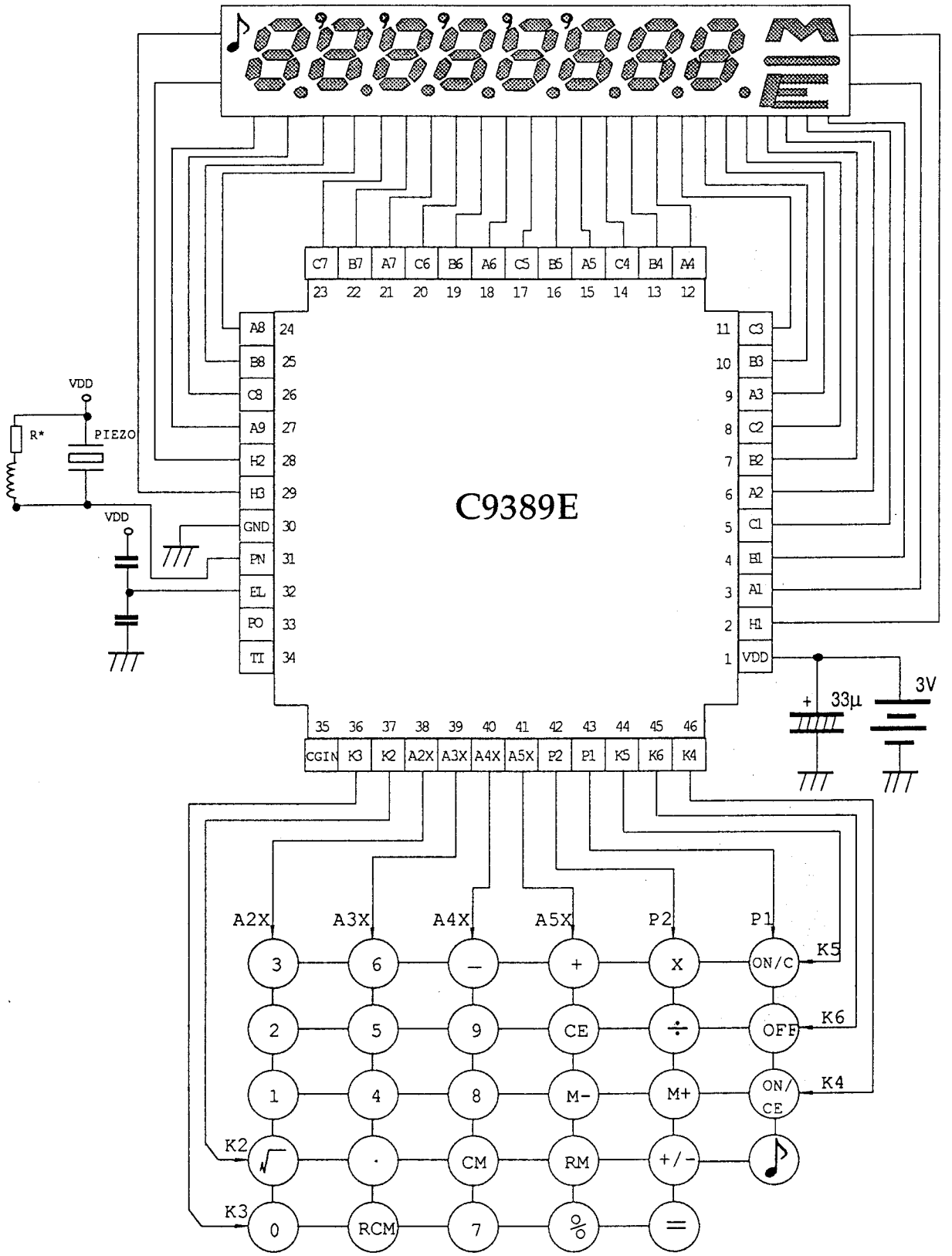


APPLICATION DIAGRAM



Note: Chip substrate must be floating or connected to GND


C9389E
VDD
R*
PIEZO
VDD
3V
33μ
A2X
A3X
A4X
A5X
P2
P1
K5
K6
K4
K2
K3
ON/C
OFF
ON/CE
CM
RM
RCM
SPEAKER



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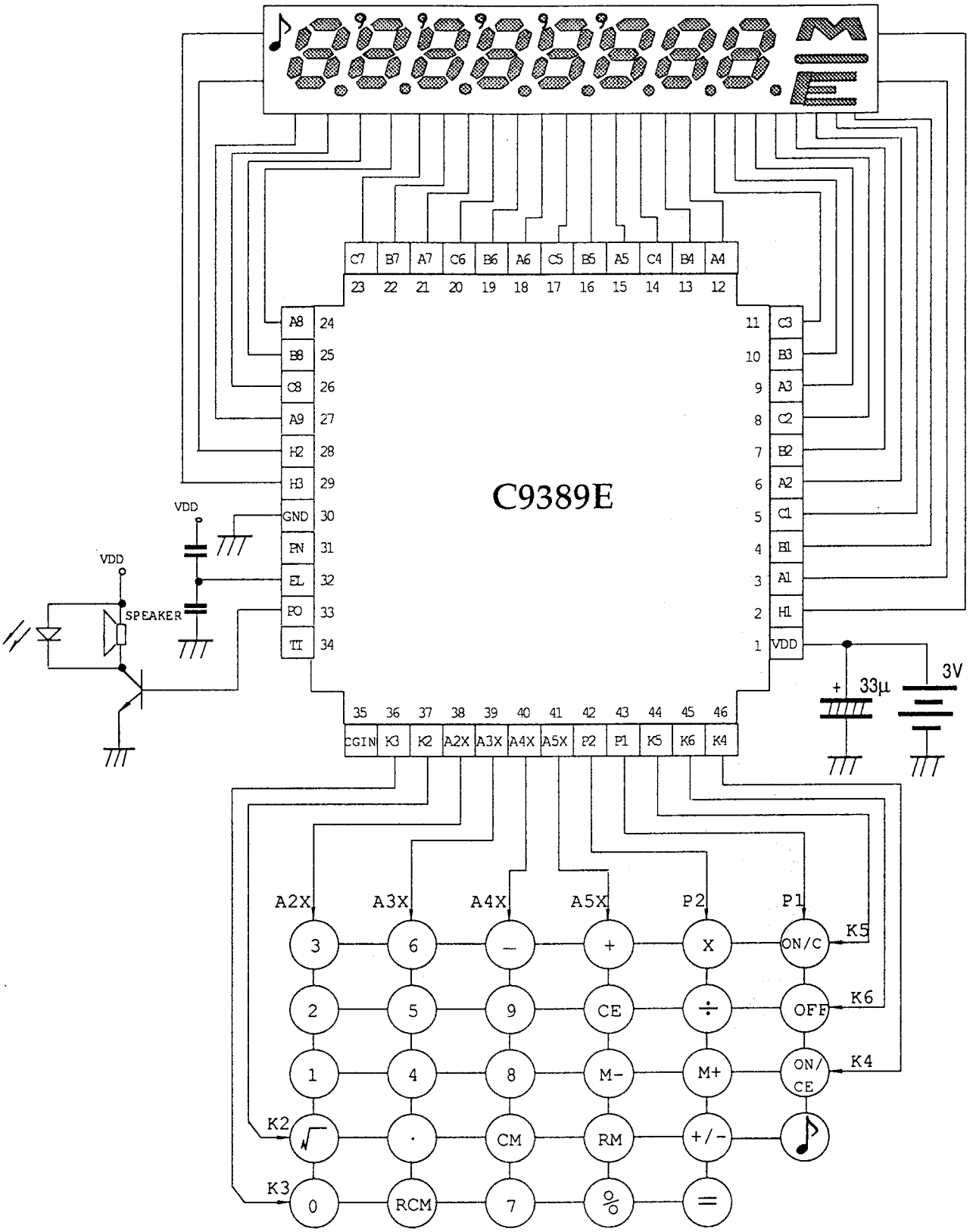

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