

GENERAL DESCRIPTION

C9399 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

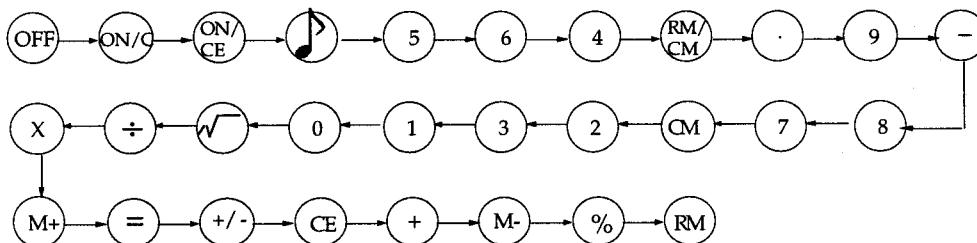
The memory contents before any error detection are protected.

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) Trailing edge : Minimum 9 words. (1 word is 3.3ms when display frequency is $F_d=100\text{Hz}$.)**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	VDD	- 0.3 ~ + 3.5	V	1
	VIN	- 0.3 ~ VDD + 0.3	V	1
Supply Voltage	VDD	2.5 ~ 3.5	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 = 3V 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 Current 1	I IH1	--	--	1	uA	Vin = VDD	3
	I IL1	--	5.5	10		Vin = 0V	
Output Voltage 1	VOH1	VDD-0.15	--	--	V	No load	4
	VOL1	--	--	0.15		IOUT = 15uA	
Output Voltage 2	VOA	2.80	2.95	--	V	No load	5
	VOB	1.30	1.50	1.70		No load	
	VOC	--	0	0.20		No load	
Display Frequency	Fd	50	65	--	Hz	VDD = 3V while display is ON.	5
Dissipation Current	I OFF	--	--	0.1	uA	Display is OFF	6
	IDIS	--	20	30		VDD = 3V while display is ON.	7
Touch Tone Output Drive Current	IOL	1.0	1.5	--	MA	VDD = 3V VOL = 0.5V TI = 3V	8
	IOH	1.0	1.3	--		VDD = 3V VOH = 2.5V TI = 0V	

Note 2 : Applies to Pins K2 ~ K6, TI.

Note 3 : Applies to Pins K2 ~ K6 and TI.

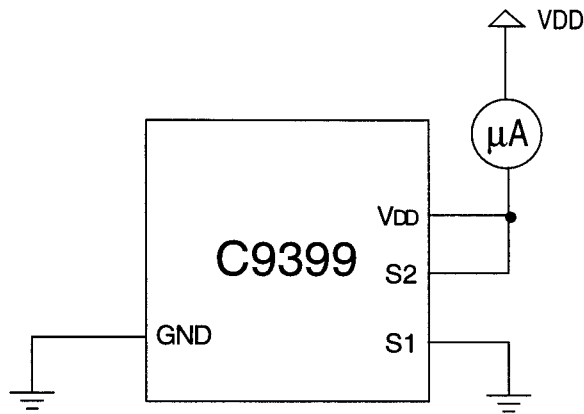
Note 4 : Applies to P1, P2, A2 ~ A5.

Note 5 : Applies to Pins H1 ~ H3, a1 ~ a9, b1 ~ b8, c1 ~ c8.

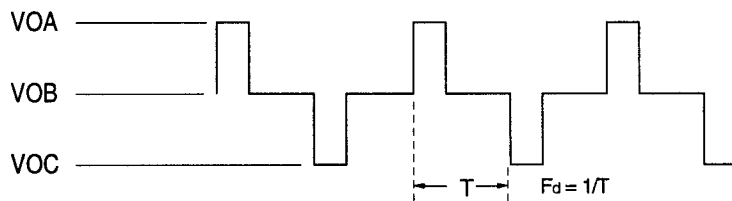
Note 6 : Miasured by the next test circuit after power supply automatically turns off.

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

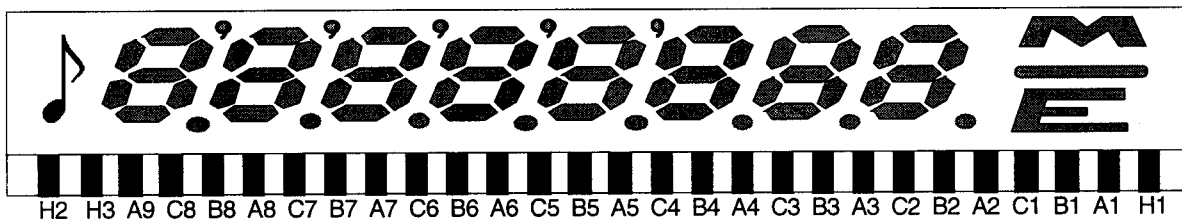
a. Numerical Font



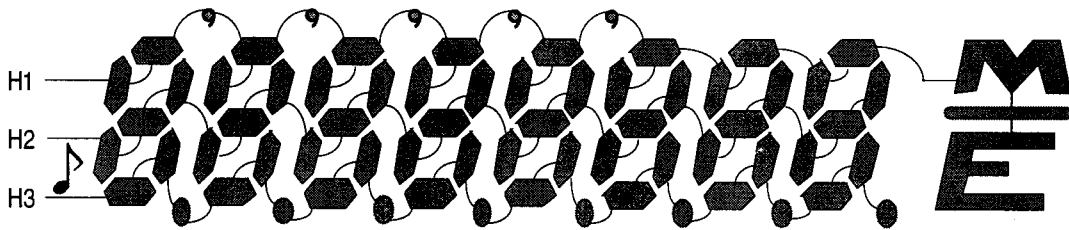
b. Sign Font



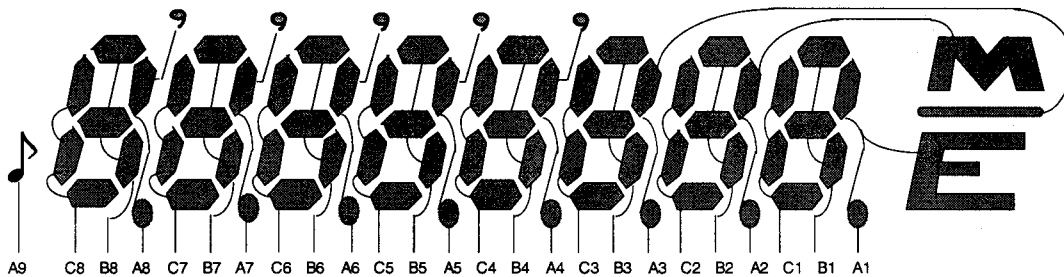
LCD CONNECTOR



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

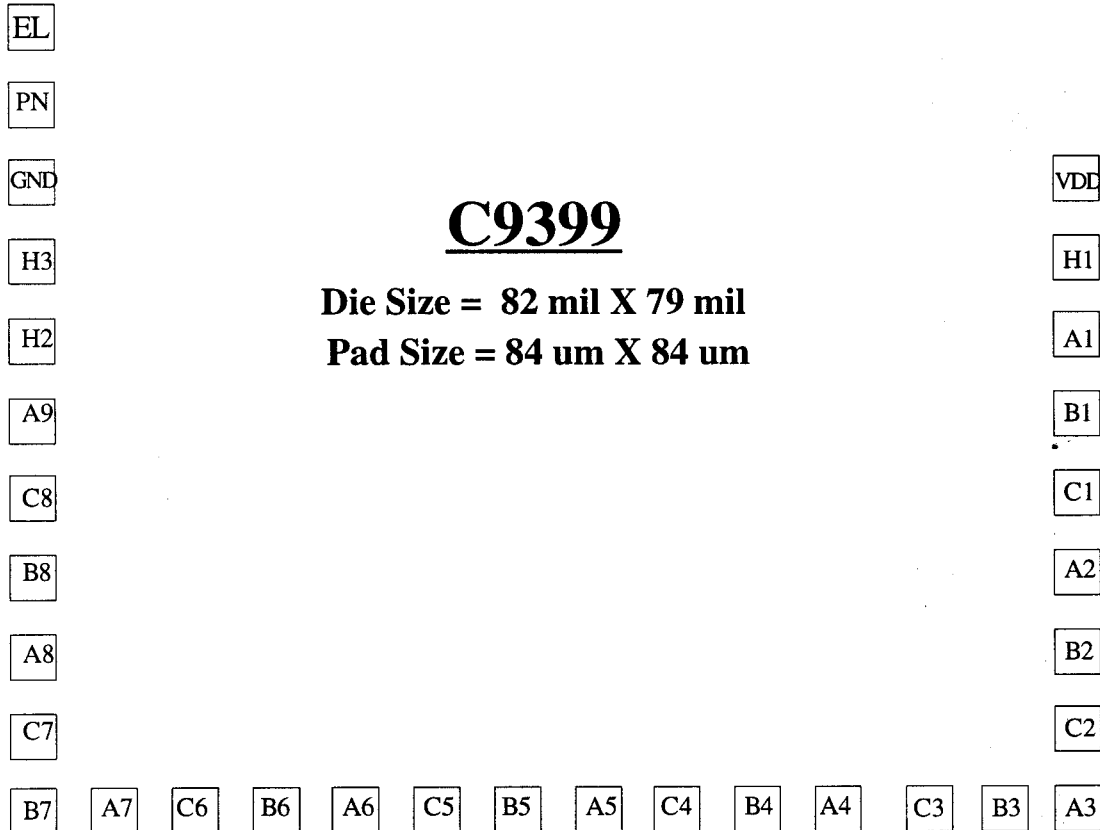
PIN DESCRIPTION

Pin No.	Signal	I/O	Description	Pin No.	Signal	I/O	Description
1	VDD	-	Power supply.	24	A8	O	Display output.
2	H1	O	Display output.	25	B8	O	Display output.
3	A1	O	Display output.	26	C8	O	Display output.
4	B1	O	Display output.	27	A9	O	Display output.
5	C1	O	Display output.	28	H2	O	Display output.
6	A2	O	Display output.	29	H3	O	Display output.
7	B2	O	Display output.	30	GND	-	Ground.
8	C2	O	Display output.	31	PN	O	Piezo output with transistor.
9	A3	O	Display output.	32	EL		
10	B3	O	Display output.	33	PO	O	Piezo output.
11	C3	O	Display output.	34	TI	I	Test input.
12	A4	O	Display output.	35	CGIN	I	Input terminal for CG.
13	B4	O	Display output.	36	K3	I	Key input
14	C4	O	Display output.	37	K2	I	Key input.
15	A5	O	Display output.	38	A2X	O	Strobe output
16	B5	O	Display output.	39	A3X	O	Strobe output.
17	C5	O	Display output.	40	A4X	O	Strobe output.
18	A6	O	Display output.	41	A5X	O	Strobe output.
19	B6	O	Display output.	42	P2	O	Strobe output.
20	C6	O	Display output.	43	P1	O	Strobe output.
21	A7	O	Display output.	44	K5	I	Key input.
22	B7	O	Display output.	45	K6	I	Key input.
23	C7	O	Display output.	46	K4	I	Key input.

*APO : Auto Power Off

PAD DIAGRAM

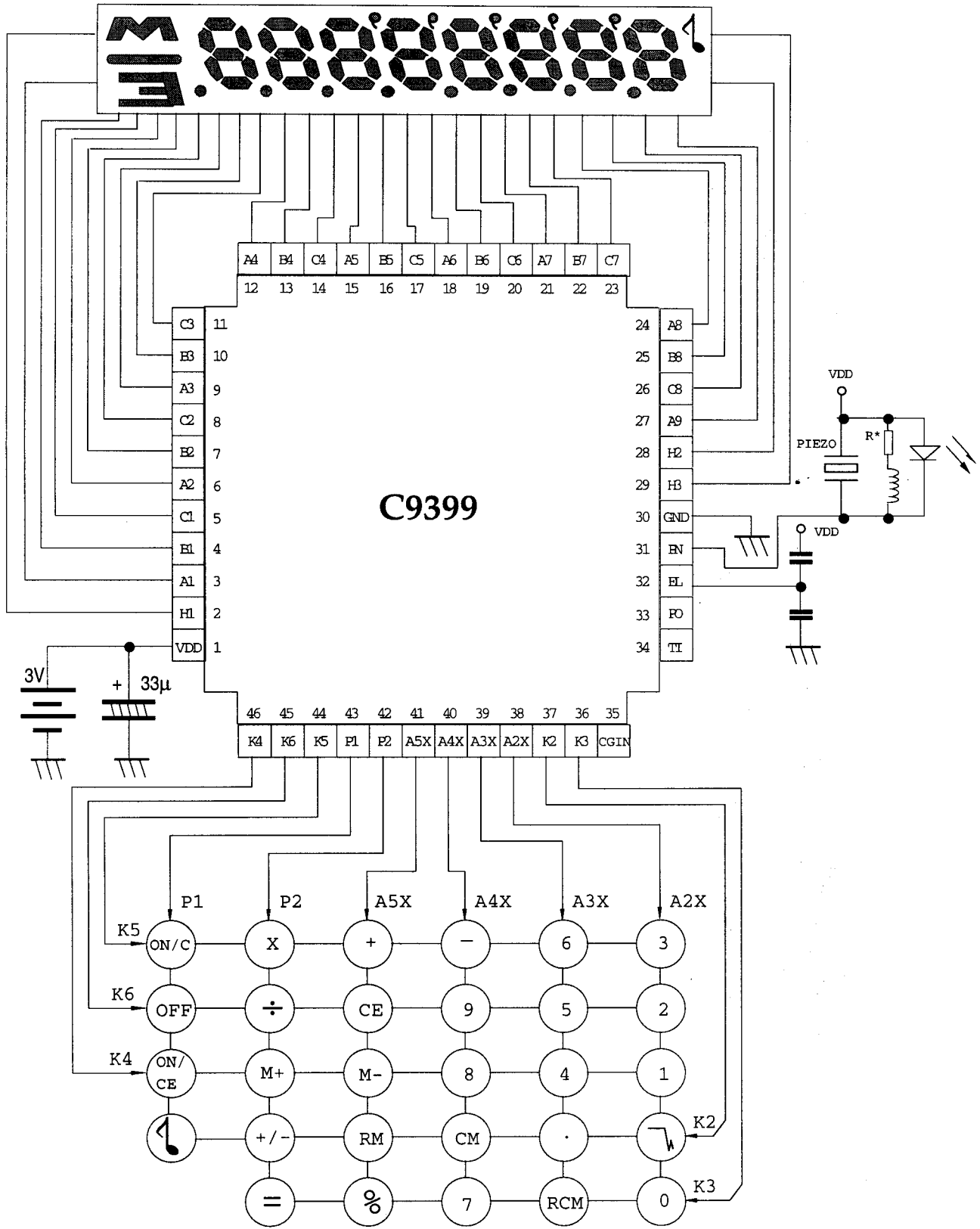
PO TI CGIN K3 K2 A2X A3X A4X A5X P2 P1 K5 K6 K4



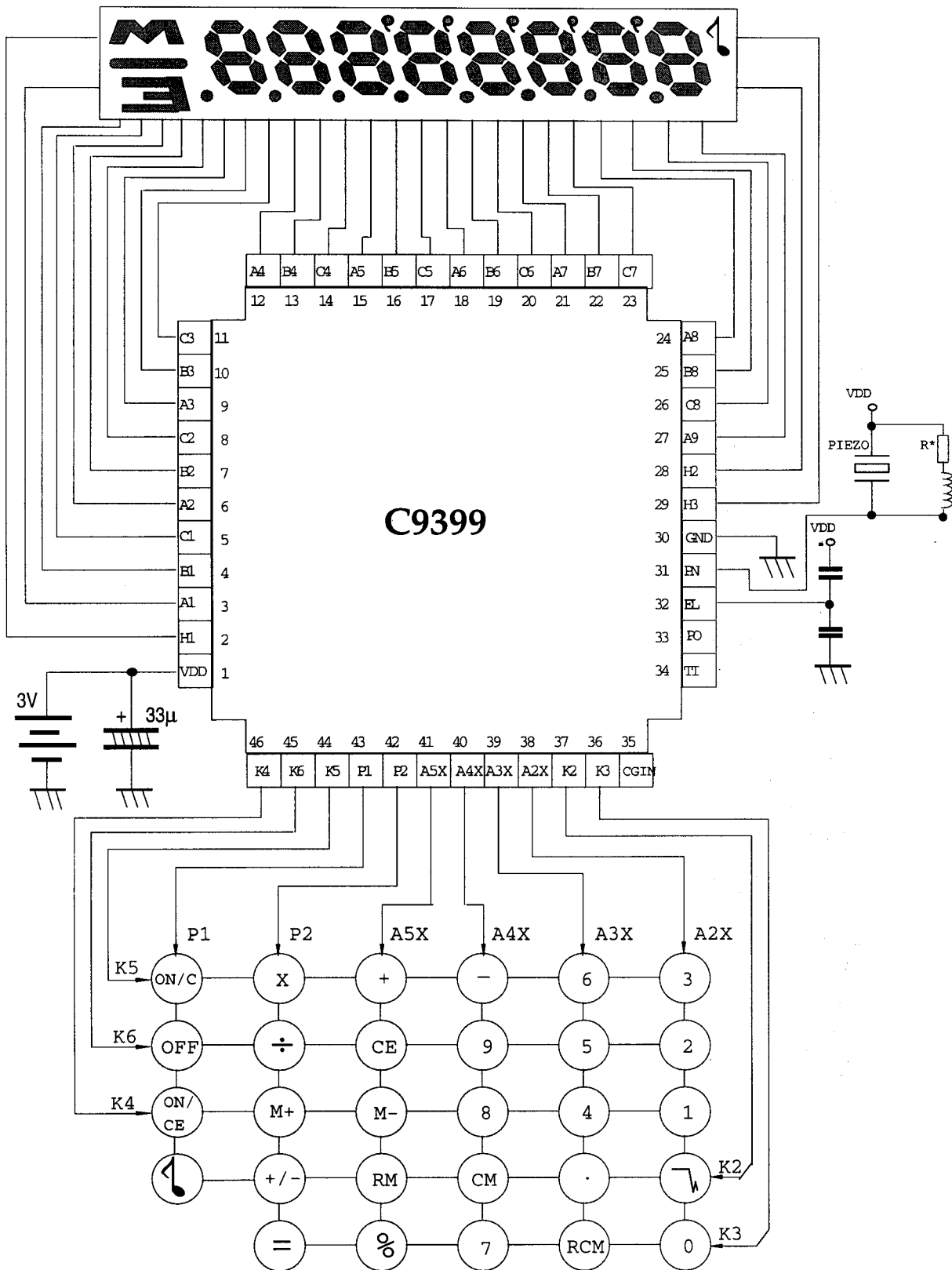
The Co-ordinate of Low Left Corner for Each Pad

B7(-945.0, -908.2)	A3 (863.4, -908.2)	K4 (861.0, 826.7)	PO (-946.0, 826.7)
A7(-804.6, -908.2)	C2 (863.4, -768.0)	K6 (722.0, 826.7)	EL (-945.0, 481.8)
C6(-665.6, -908.2)	B2 (863.4, -629.0)	K5 (583.0, 826.7)	PN (-945.0, 342.8)
B6(-526.6, -908.2)	A2 (863.4, -490.0)	P1 (444.0, 826.7)	GND(-945.0, 203.8)
A6(-387.6, -908.2)	C1 (863.4, -351.0)	P2 (305.0, 826.7)	H3 (-945.0, 64.8)
C5(-248.6, -908.2)	B1 (863.4, -212.0)	A5X (166.0, 826.7)	H2 (-945.0, -74.2)
B5(-109.6, -908.2)	A1 (863.4, -73.0)	A4X (27.0, 826.7)	A9 (-945.0, -213.2)
A5(29.4, -908.2)	H1 (863.4, 66.3)	A3X (-112.0, 826.7)	C8 (-945.0, -352.2)
C4(168.4, -908.2)	VDD(863.3, 205.3)	A2X (-251.0, 826.7)	B8 (-945.0, -491.2)
B4(307.4, -908.2)		K2 (-390.0, 826.7)	A8 (-945.0, -630.2)
A4(446.4, -908.2)		K3 (-529.0, 826.7)	C7 (-945.0, -769.2)
C3(585.4, -908.2)		CGIN (-668.0, 826.7)	
B3(724.4, -908.1)		TI (-807.0, 826.7)	

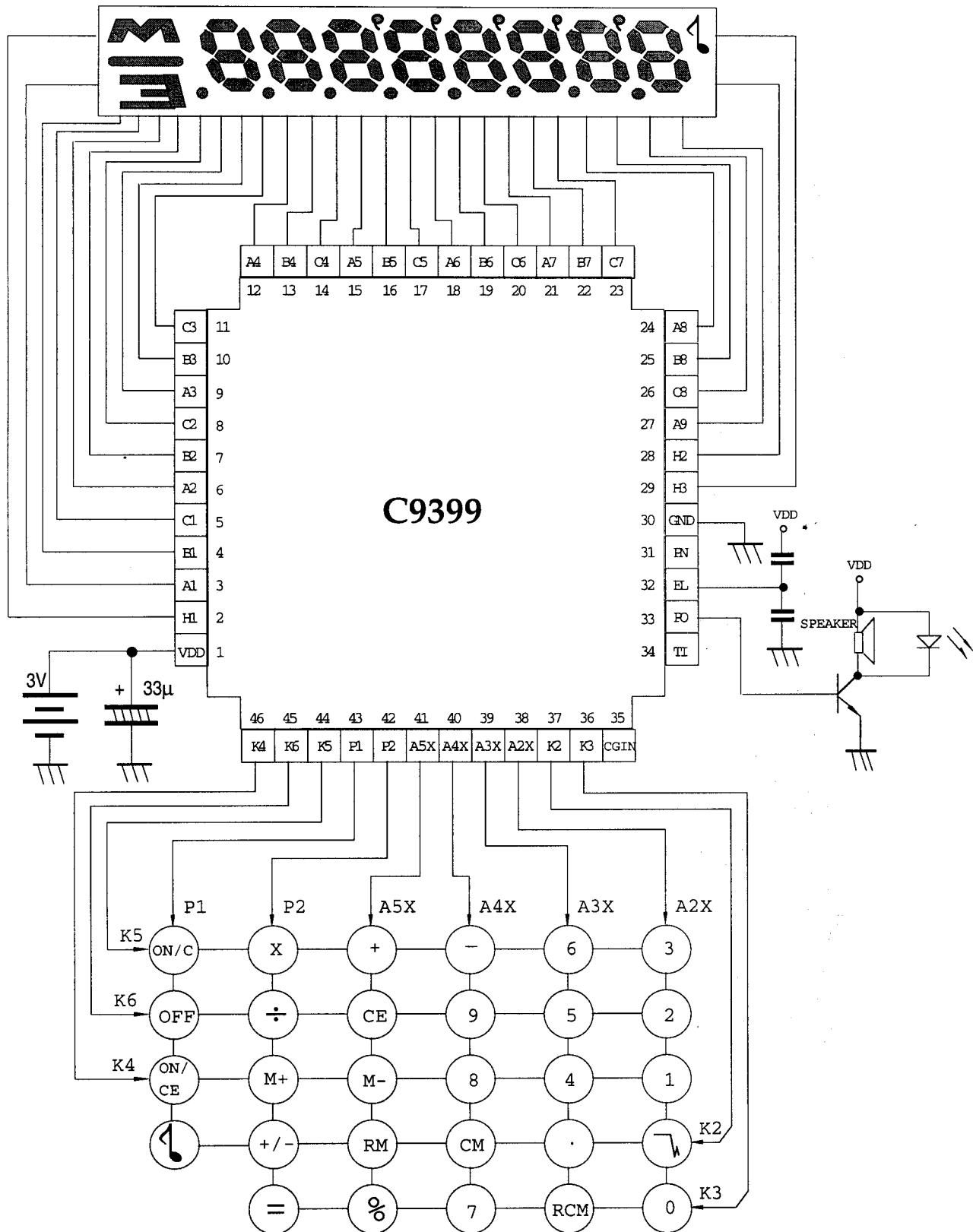
APPLICATION DIAGRAM



Note: Chip substrate must be floating or connected to GND



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