Features

- Operating voltage:2.4-5.2V

- Built-in 32kHz RC oscillator default

- 1/4 BIAS

- 1/8 duty (8 COM)

- Built-in 48× 8bit display RAM

- Selection of buzzer frequencies 2kHz、4kHz

- STANDBY mode by Cmd LCD OFF,SYS DIS）

- 3 wire serial interface

- Software configuration LCD parameters

- Data mode and command mode instructions

- Write address auto increment

- VLCD pin for adjusting LCD operating voltage（≤VDD）

- Package:
  LQFP64(7.0mm x 7.0mm PP=0.4mm)

1 General Description

VK0384 is a RAM Mapping 48x8 LCD Driver，It can support LCD screens with a maximum of 384 pattern(48SEGx8COM).Only 3 or 4 lines are required to communication interface with the VK0384,it is used to configure display parameters and transfer display data, and can also enter the standby mode through Power down command（by Cmd LCD OFF,SYS DIS）.

2.Pinouts and pin description

2.1 VK0384 LQFP64 Pin Assignment
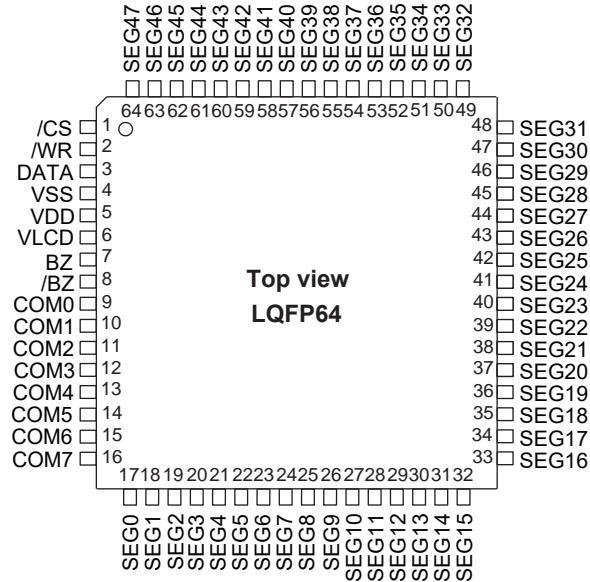
2.2 VK0384 LQFP64 Pin Description

No.	Name	I/O	Function
1	/CS	I	Chip selection input with pull-up resistor 1-disabe 0-enable.
2	/WR	I	WRITE clock input with pull-up resistor, data latched on the rising edge of the /WR signal.
3	DATA	I/O	Serial data input/output with pull-high resistor.
4	VSS	VSS	Negative power supply
5	VDD	VDD	Positive power supply
6	VLCD	I	LCD power input
7	BZ	O	2kHz or 4kHz tone frequency output pair ,
8	/BZ	O	when TONE OFF the BZ and /BZ pins output low level.
9-16	COM0-COM7	O	LCD COM outputs
17-64	SEG0-SEG47	O	LCD SEG outputs

3 Functional Description

3.1 Block diagram
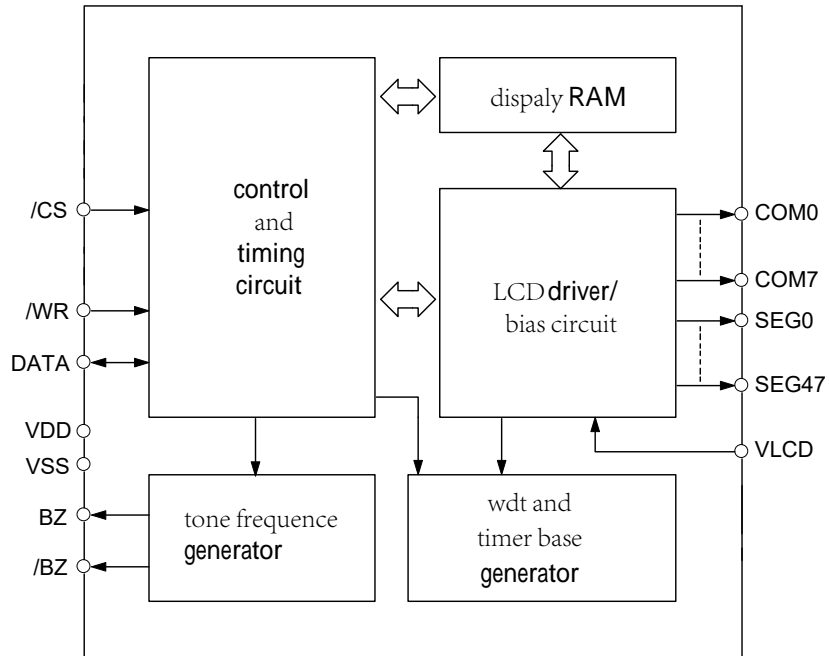
3.2 Display RAM

The static display memory (RAM) is organized into 48×8 bits and stores the displayed data. The contents of the RAM are directly mapped to the contents of the LCD driver. Data in the RAM can be accessed by the WRITE command.

The following is a mapping from the RAM to the LCD pattern:

	COM7	COM6	COM5	COM4		COM3	COM2	COM1	COM0	
SEG0					1					0	.
SEG1					3					2	
SEG2					5					4	
SEG3					7					6	address 7 bit
											（A6---A0）
SEG47					95					94	
	D3	D2	D1	D0	Data\Addr	D3	D2	D1	D0	Data\Addr	

3.3 Tone Output

VK0384 has a simple 2KHz / 4kHz tone generator，it can output a pair of differential driving signals on the BZ and /BZ, which are used to generate a single tone By executing the TONE4K and TONE2K commands there are two tone frequency outputs selectable .The tone output can be turned on or off by invoking the TONE 4k/TONE 2k or the TONE OFF command. The tone outputs, namely BZ and /BZ, are a pair of differential driving outputs used to drive a piezo buzzer. Once the system is disabled or the tone output is inhibited, the BZ and the /BZ outputs will remain at low level.

3.4 LCD Driver

The VK0384 is a 384 (48×8) pattern LCD driver, 1/4bias and 1/8duty (8 com).

3.4.1 Communication Interfacing

3 lines are required to interface with the VK0384.

The /CS pin is used to initialize the serial interface circuit and to terminate the communication with HOST.

The DATA pin is the serial data input/output line. Data to be read or written or commands to be written have to be passed through the DATA line.

The /WR line is the WRITE clock input. The data, address, and command on the DATA line are all clocked into the VK0384 on the rising edge of the WR signal.

3.4.2 Command Format

VK0384 can be configured by the Software setting. There are two mode commands to configure the LCD parameters and to transfer the LCD display data,The configuration mode of the VK0384 is called command mode, and its command mode ID is 1 00. The data mode includes WRITE operations   ID is 1 01.

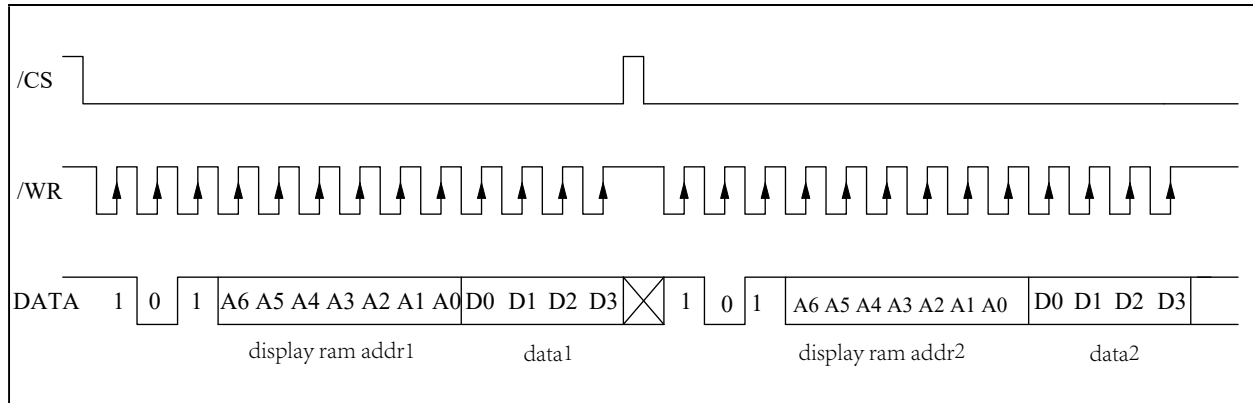The following are the data mode IDs and the command mode ID:

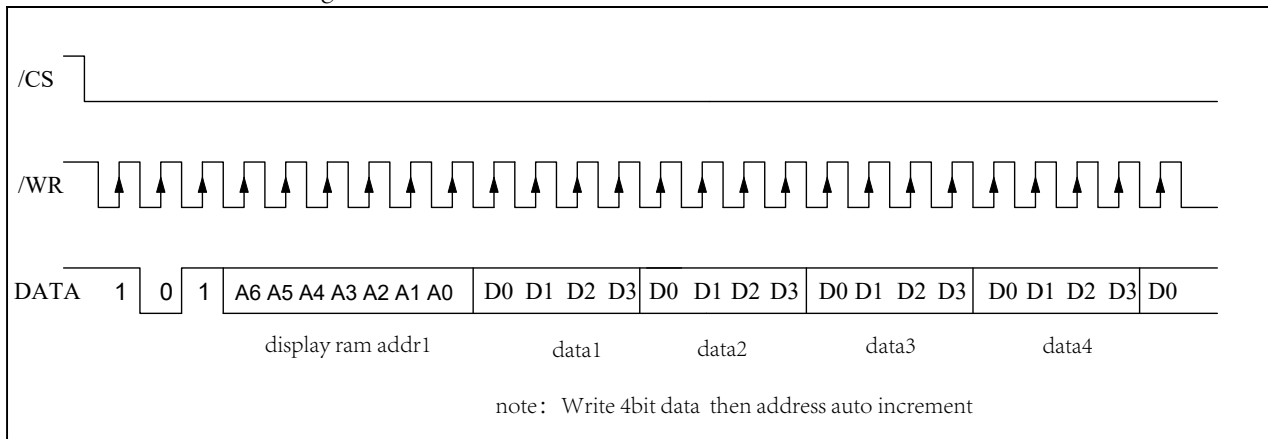| Operation	MODE	ID
WRITE	DATA	101
COMMAND	COMMAND	100

3.4.3 Cmd/Data Timing Diagrams

The following are the data mode IDs and the command mode ID Timing Diagrams。

3.4.3.1 WRITE Mode

Command Code : 101

/CS

/WR

DATA 1 0 1 A6 A5 A4 A3 A2 A1 A0 D0 D1 D2 D3 1 0 1 A6 A5 A4 A3 A2 A1 A0 D0 D1 D2 D3

display ram addr1 data1 display ram addr2 data2

Successive Address Writing

/CS

/WR

DATA 1 0 1 A6 A5 A4 A3 A2 A1 A0 D0 D1 D2 D3 D0 D1 D2 D3 D0 D1 D2 D3 D0 D1 D2 D3 D0

display ram addr1 data1 data2 data3 data4

note：Write 4bit data then address auto increment

3.4.3.2 Command Mode

Command Code : 100
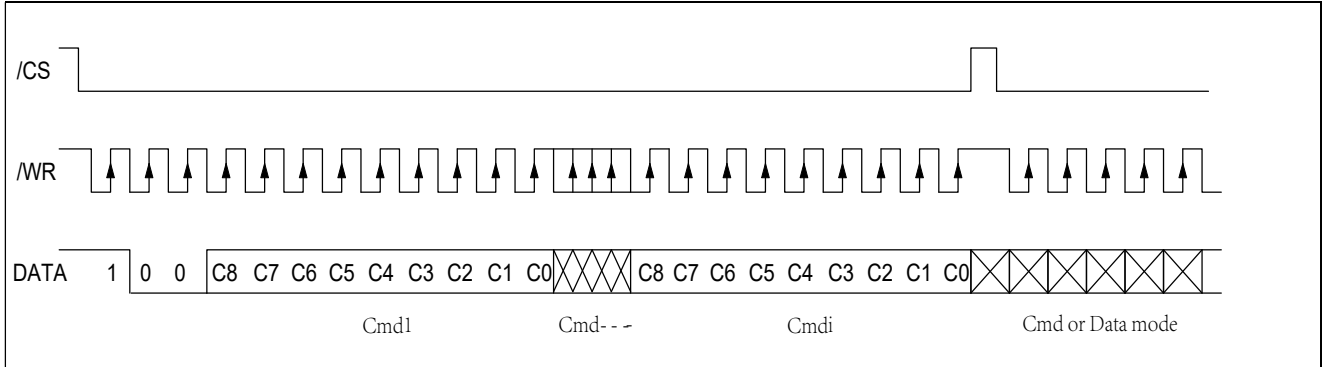
3.4.3.3 Data and Command Mode

Data and Command Mode

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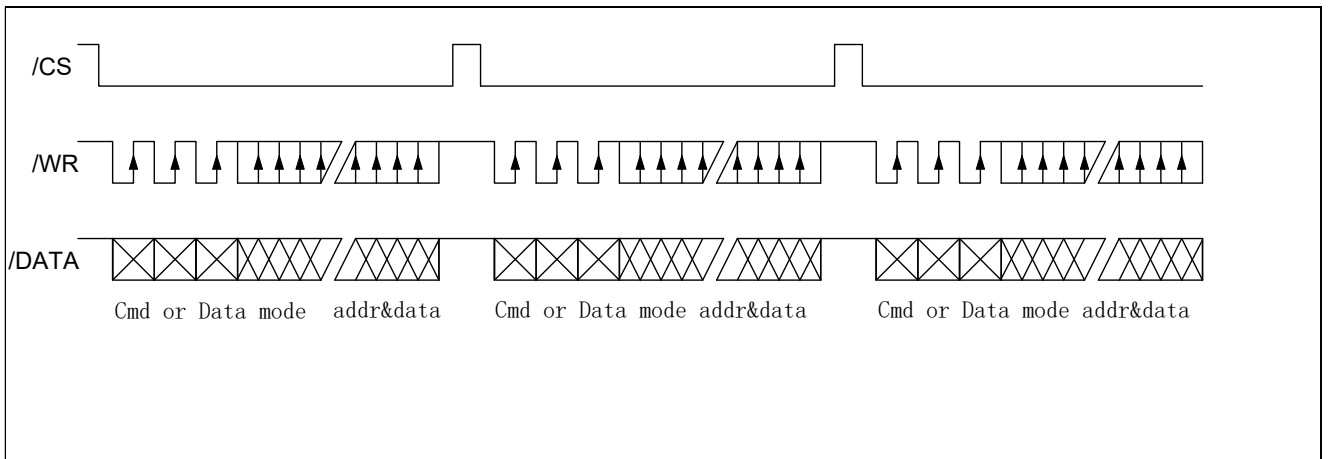
4 Command Summary

Name	ID	Command Code	D/C	Function	Def.
WRITE	101	A6A5A4A3A2A1A0D0D1D2D3	D	Write data to the RAM	
SYS DIS	100	0000- 0000-X	C	Turn off system oscillator	YES
SYS EN	100	0000- 0001-X	C	Turn on system oscillator	
LCD OFF	100	0000- 0010-X	C	Turn off LCD bias generator	YES
LCD ON	100	0000- 0011-X	C	Turn on LCD bias generator	
TONE OFF	100	0000- 1000-X	C	Turn off tone outputs	YES
RC 32k	100	0001-10XX-X	C	on-chip RC oscillator	YES
TONE 4k	100	010X-XXXX-X	C	Tone frequency, 4kHz	
TONE 2k	100	011X-XXXX-X	C	Tone frequency, 2kHz	
TEST	100	1110-0000- X	C	Test mode	
NORMAL	100	1110-0011- X	C	Normal mode	YES

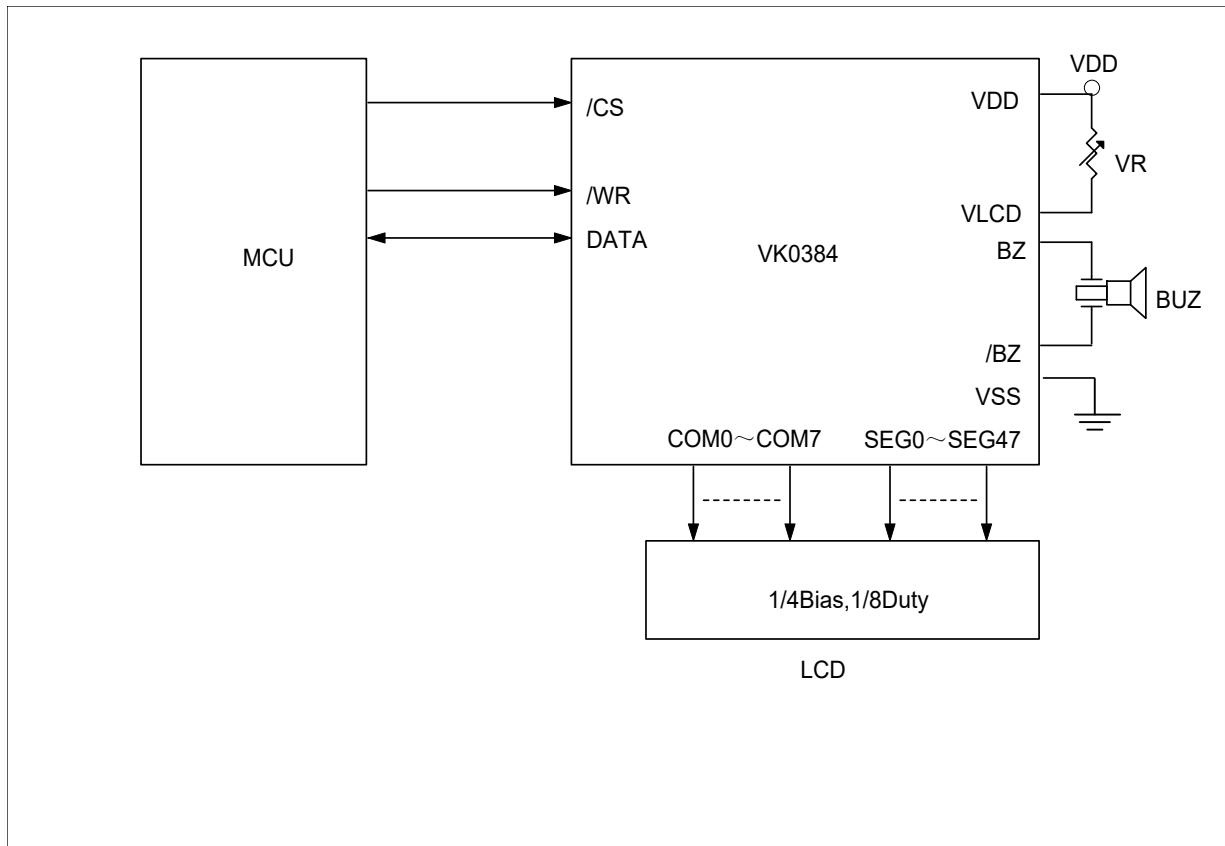Note：X: 0 or 1

A6-A0: Display RAM addresses

D3-D0: 4bit Display RAM data

D/C:Data/Command mode

Def.:Power on reset default

101and 100 is Command ID

5 Application Circuits

Note：Adjust VR(20K) to fit user's LCD panel display voltage (VLCD)

6 Electrical characteristics

6.1 Absolute Maximum Ratings

*UFN	4ZNCPM	3BUJOHT	6OJU
Power voltage	VDD	-0.3～5.5	V
Input Voltage	VIN	V_{SS}-0.3～V_{DD}+0.3	V
Storage Temperature	T_{STG}	-50～+125	℃
Operating Temperature	T_{OTG}	-40～+85	℃

6.2 DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
						VDD	Conditions
Operating voltage	V_{DD}	2.4	—	5.2	V	—	—
Operating current	I_{DD1}	—	155	310	μA	3V	No load/LCD ON On-chip RC oscillator
		—	260	420		5V	
Operating current	I_{DD11}	—	8	30	μA	3V	No load/LCD OFF On-chip RC oscillator
		—	20	60		5V	
Standby Current	I_{STB}	—	1	10	μA	3V	No load, Power down mode
		—	2	20		5V	
Input Low Voltage	V_{IL}	0	—	0.6	V	3V	DATA, /WR, /CS, /RD
		0	—	1.0		5V	
Input High Voltage	V_{IH}	2.4	—	3.0	V	3V	DATA, /WR, /CS, /RD
		4.0	—	5.0		5V	
BZ, /BZ, /IRQ	I_{OL1}	0.9	1.8	—	mA	3V	V_{OL}=0.3V
		1.7	3.0	—		5V	V_{OL}=0.5V
BZ, /BZ	I_{OH1}	-0.9	-1.8	—	mA	3V	V_{OH}=2.7V
		-1.7	-3.0	—		5V	V_{OH}=4.5V
DATA	I_{OL1}	0.9	1.8	—	mA	3V	V_{OL}=0.3V
		1.7	3.0	—		5V	V_{OL}=0.5V
DATA	I_{OH1}	-0.9	-1.8	—	mA	3V	V_{OH}=2.7V
		-1.7	-3.0	—		5V	V_{OH}=4.5V
LCD COM Sink Current	I_{OL2}	80	160	—	μA	3V	V_{OL}=0.3V
		180	360	—		5V	V_{OL}=0.5V
LCD COM Source Current	I_{OH2}	-40	-80	—	μA	3V	V_{OH}=2.7V
		-90	-180	—		5V	V_{OH}=4.5V
LCD SEG Sink Current	I_{OL3}	50	100	—	μA	3V	V_{OL}=0.3V
		120	240	—		5V	V_{OL}=0.5V
LCD SEG Source	I_{OH3}	-30	-60	—	μA	3V	V_{OH}=2.7V
		-70	-140	—		5V	V_{OH}=4.5V
Pull-UP Resistor	R_{UP}	100	200	300	k Ω	3V	DATA, /WR, /CS, /RD
		50	100	150		5V	

6.3 AC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions	
						VDD	Conditions
System Clock	f_{SYS1}	22	32	40	kHz	3V	On-chip RC oscillator
		24	32	40		5V	
LCD Clock	f_{LCD1}	44	64	80	Hz	3V	On-chip RC oscillator
		48	64	80	Hz	5V	
LCD Common Period	t_{COM}	—	N/f_{LCD}	—	sec	—	N: Number of COM
Serial Data Clock（/WR）	F_{CLK1}	—	—	150	kHz	3V	Duty cycle 50%
		—	—	300		5V	
Serial Data Clock（/RD）	F_{CLK2}	—	—	75	kHz	3V	Duty cycle 50%
		—	—	150		5V	
Serial Interface Reset PW	t_{CS}	—	250	—	ns	—	/CS
/WR，/RD Input Pulse Width	t_{CLK}	3.34	—	—	μs	3V	Write mode
		6.67	—	—			Read mode
		1.67	—	—	μs	5V	Write mode
		3.34	—	—			Read mode
Rise/Fall Time Serial Data Clock Width	t_r，t_f	—	120	—	ns	3V	—
						5V	
Setup Time for DATA to /WR, /RD Clock Width	t_{su}	—	120	—	ns	3V	—
						5V	
Hold Time for DATA to /WR, /RD Clock Width	t_h	—	120	—	ns	3V	—
						5V	
Setup Time for /CS to /WR, /RD Clock Width	t_{su1}	—	100	—	ns	3V	—
						5V	
Hold Time for /CS to /WR, /RD Clock Width	t_{h1}	—	100	—	ns	3V	—
						5V	
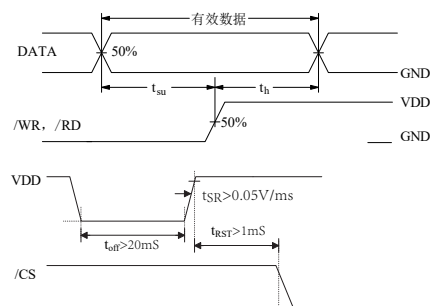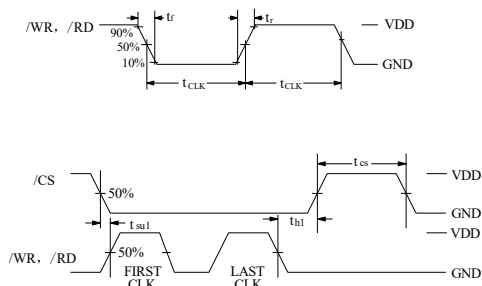
7.Package Information

7.1 LQFP64(7.0mm x 7.0mm PP=0.4mm)：
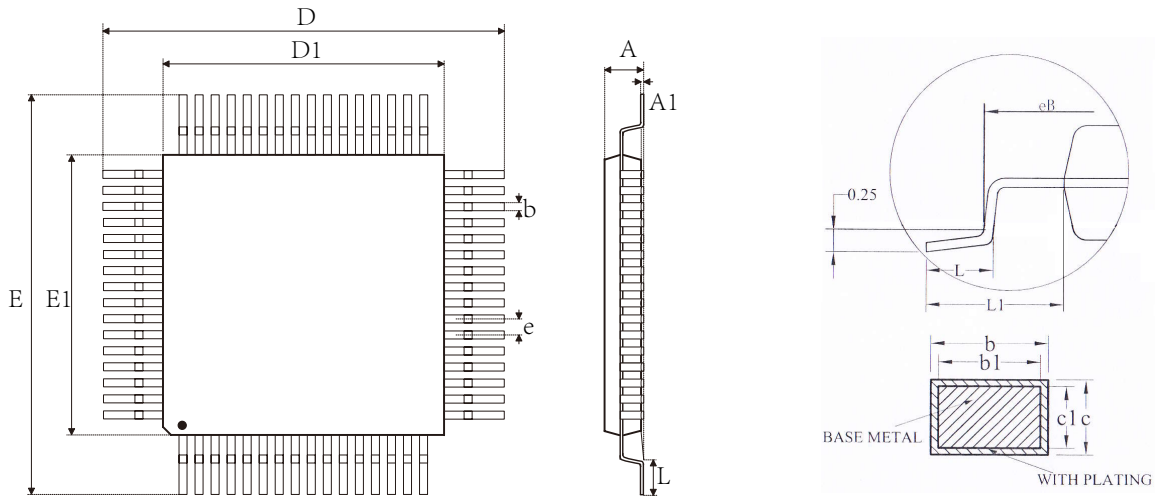
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.60
A1	0.05	--	0.15
b	0.16	--	0.24
b1	0.15	0.18	0.21
c	0.13	--	0.17
c1	0.12	0.13	0.14
D	8.80	9.00	9.20
D1	6.90	7.00	7.10
E	8.80	9.00	9.20
E1	6.90	7.00	7.10
e	0.40BSC		
L	0.45	--	0.75
L1	1.00REF		

8 Revision history

No.	Version	Date	Modify the content	Check
1	1.0	2018-08-10	Original version	Yes
2	1.1	2018-10-11	Add Ref circuits	Yes
3	1.2	2019-03-21	Check para	Yes
4	1.3	2020-04-11	Update content	Yes

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