

## Features

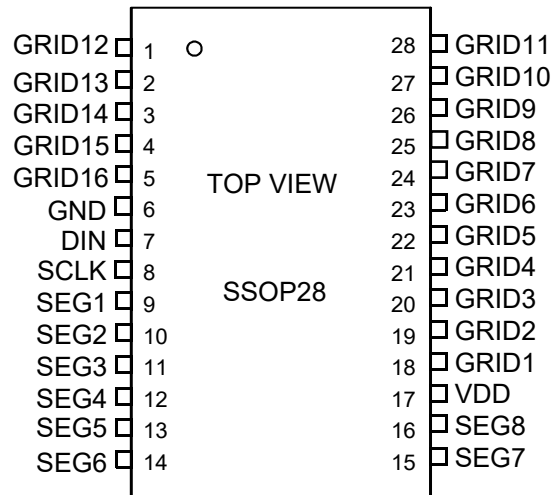
- Operating voltage 3.0-5.5V
- Built-in RC oscillator
- 8 SEG pins, 16 GRID pins
- SEG pins connect to LED Anode , GRID pins connect to LED Cathode
- 2-wire serial interface
- 8-level brightness control
- Built-in 8×16 bit display RAM
- Power-On Reset(POR)
  
- Package:  
SSOP28(150mil) (9.9mm x 3.9mm PP=0.635mm)

## 1 General Description

VK1640A is a RAM Mapping LED display driver, LED display numbers in the device is 128 patterns (8SEG x 16COM). SEG pins connect to LED Anode, GRID pins connect to LED Cathode. It is suitable for small LED display driver. SSOP28 package.

## 2 Pinouts and pin description

### 2.1 VK1640A SSOP28 Pin Assignment

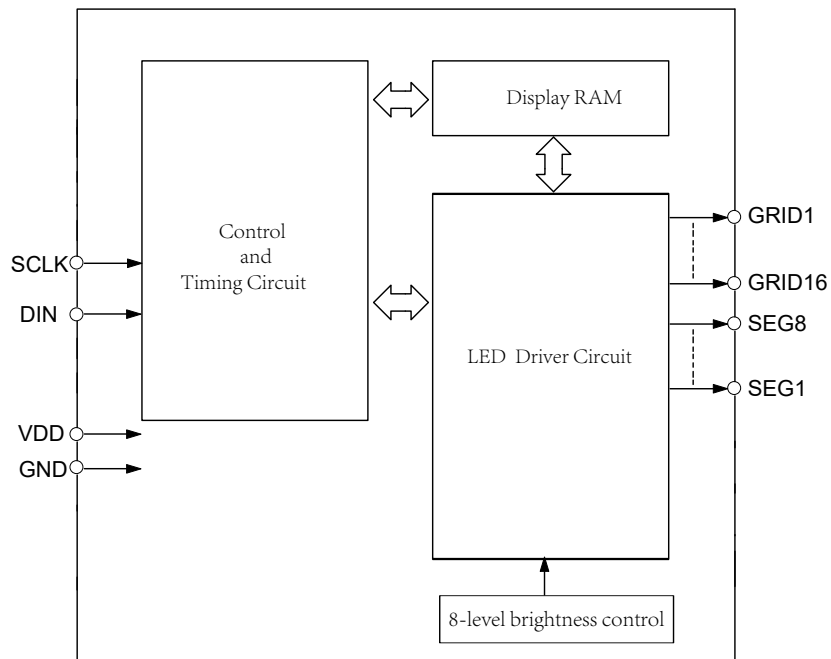


## 2.2 VK1640A SSOP28 Pin Description

| No.          | Name         | I/O | Function                                                                                                      |
|--------------|--------------|-----|---------------------------------------------------------------------------------------------------------------|
| 1-5<br>18-28 | GRID1-GRID16 | O   | LED GRID outputs (N-MOS open drain )                                                                          |
| 6            | GND          | GND | Negative power supply                                                                                         |
| 7            | DIN          | I   | Serial data input,<br>the data changes at the low level of SCLK and is transmitted at the high level of SCLK. |
| 8            | SCLK         | I   | Serial clock input,<br>Read the input data to the display RAM on the rising edge.                             |
| 9-16         | SEG1-SEG8    | O   | LED SEG outputs (P-MOS open drain )                                                                           |
| 17           | VDD          | VDD | Positive power supply                                                                                         |

## 3 Functional Description

### 3.1 Block diagram



## 3.2 Display RAM

The static display memory (RAM) is organized into  $8 \times 16$  bits and stores the displayed data. The contents of the RAM are directly mapped to the contents of the LCD driver. Display address is 0xC0-0xCF, the RAM size is 16 bytes. If you want to lighted on or off an LED, only set or clear the corresponding display RAM bit to 1 or 0. For example, if LED1 driven by SEG1 pin and GRID1 pin is on or off, only set bit0 to 1 or 0 of the corresponding display RAM (0xC0). The ram bit corresponding to the unused SEG pin is cleared to 0.

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

| SEG<br>GRID | SEG8 | SEG7 | SEG6 | SEG5 | SEG4 | SEG3 | SEG2 | SEG1                                                                              | Address |
|-------------|------|------|------|------|------|------|------|-----------------------------------------------------------------------------------|---------|
| GRID1       |      |      |      |      |      |      |      |  | 0xC0    |
| GRID2       |      |      |      |      |      |      |      |                                                                                   | 0xC1    |
| GRID3       |      |      |      |      |      |      |      |                                                                                   | 0xC2    |
| GRID4       |      |      |      |      |      |      |      |                                                                                   | 0xC3    |
| GRID5       |      |      |      |      |      |      |      |                                                                                   | 0xC4    |
| GRID6       |      |      |      |      |      |      |      |                                                                                   | 0xC5    |
| GRID7       |      |      |      |      |      |      |      |                                                                                   | 0xC3    |
| GRID8       |      |      |      |      |      |      |      |                                                                                   | 0xC4    |
| GRID9       |      |      |      |      |      |      |      |                                                                                   | 0xC5    |
| GRID10      |      |      |      |      |      |      |      |                                                                                   | 0xC2    |
| GRID11      |      |      |      |      |      |      |      |                                                                                   | 0xC3    |
| GRID12      |      |      |      |      |      |      |      |                                                                                   | 0xC4    |
| GRID13      |      |      |      |      |      |      |      |                                                                                   | 0xC5    |
| GRID14      |      |      |      |      |      |      |      |                                                                                   | 0xCD    |
| GRID15      |      |      |      |      |      |      |      |                                                                                   | 0xCE    |
| GRID16      |      |      |      |      |      |      |      |                                                                                   | 0xCF    |
|             | D7   | D6   | D5   | D4   | D3   | D2   | D1   | D0                                                                                |         |

Note:

At the initial system power on, the value stored in the chip display RAM may be random. It is recommended to clear the display RAM after power on, write 0x00 to the all display RAM (0xC0-0xCF).

SEG pins connect to LED Anode, GRID pins connect to LED Cathode, Reverse connection is not allowed.

### 3.3 Serial Communication Command

#### 3.3.1 Communication Interfacing

2 lines are required to interface with the VK1640A

The SCLK line is the clock input, the data on the DATA line are Transmitted into the VK1640A on the rising edge of the SCLK signal.

The DIN pin is the serial data input, data changes at the low level of SCLK and is transmitted at the high level of SCLK. The starting condition is that when SCLK high, DIN changes from high to low; The end condition is that when SCLK is high, DIN changes from low to high.

#### 3.3.2 Command Format

Command is used to set the Display Mode or write the Display Data.

After Start signal, the first byte input by DIN is used as the command byte, After decoding, Bit7 and bit6 of the byte are the command bits, as shown in the following table:

| bit7 | bit6 | Command Function        |
|------|------|-------------------------|
| 0    | 1    | Data Write Set Command  |
| 1    | 0    | Display Control Command |
| 1    | 1    | Address Set Command     |

### 3.3.3 Command Description

#### 3.3.3.1 Data Write Set Command

This command is used to write Display data and related commands. Bit1 and bit0 bits are not allowed to be set to 01 or 11.

when powered on, bit3-bit0 data is 0.

| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 | Function      | Note                  |
|------|------|------|------|------|------|------|------|---------------|-----------------------|
| 0    | 1    | ---  |      |      |      | 0    | 0    | Write data    | Write data to the RAM |
| 0    | 1    |      |      |      | 0    |      |      | Address mode  | address increase      |
| 0    | 1    |      |      |      | 1    |      |      | set           | address fixed         |
| 0    | 1    |      | 0    |      |      |      |      | work mode set | normal mode           |
| 0    | 1    |      | 1    |      |      |      |      |               | test mode             |



### 3.3.3.2 Address Set Command

Set the address of the Display RAM (0xc0 - 0xcf). When powered on, the address is set to 0xc0(default).

| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 | RAM Address |
|------|------|------|------|------|------|------|------|-------------|
| 1    | 1    | ---  |      | 0    | 0    | 0    | 0    | 0xC0        |
| 1    | 1    |      |      | 0    | 0    | 0    | 1    | 0xC1        |
| 1    | 1    |      |      | 0    | 0    | 1    | 0    | 0xC2        |
| 1    | 1    |      |      | 0    | 0    | 1    | 1    | 0xC3        |
| 1    | 1    |      |      | 0    | 1    | 0    | 0    | 0xC4        |
| 1    | 1    |      |      | 0    | 1    | 0    | 1    | 0xC5        |
| 1    | 1    |      |      | 0    | 1    | 1    | 0    | 0xC6        |
| 1    | 1    |      |      | 0    | 1    | 1    | 1    | 0xC7        |
| 1    | 1    |      |      | 1    | 0    | 0    | 0    | 0xC8        |
| 1    | 1    |      |      | 1    | 0    | 0    | 1    | 0xC9        |
| 1    | 1    |      |      | 1    | 0    | 1    | 0    | 0xCA        |
| 1    | 1    |      |      | 1    | 0    | 1    | 1    | 0xCB        |
| 1    | 1    |      |      | 1    | 1    | 0    | 0    | 0xCC        |
| 1    | 1    |      |      | 1    | 1    | 0    | 1    | 0xCD        |
| 1    | 1    |      |      | 1    | 1    | 1    | 0    | 0xCE        |
| 1    | 1    |      |      | 1    | 1    | 1    | 1    | 0xCF        |

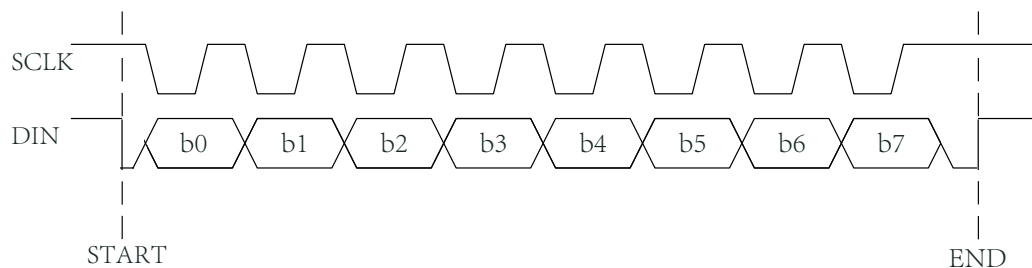
### 3.3.3.3 Display Control Command

Set the Display ON or OFF and select the Display brightness (level 8).

| bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 | Function               | Note        |
|------|------|------|------|------|------|------|------|------------------------|-------------|
| 1    | 0    | ---  |      |      | 0    | 0    | 0    | Set Output Pulse Width | 1/16 duty   |
| 1    | 0    |      |      |      | 0    | 0    | 1    |                        | 2/16 duty   |
| 1    | 0    |      |      |      | 0    | 1    | 0    |                        | 4/16 duty   |
| 1    | 0    |      |      |      | 0    | 1    | 1    |                        | 10/16 duty  |
| 1    | 0    |      |      |      | 1    | 0    | 0    |                        | 11/16 duty  |
| 1    | 0    |      |      |      | 1    | 0    | 1    |                        | 12/16 duty  |
| 1    | 0    |      |      |      | 1    | 1    | 0    |                        | 13/16 duty  |
| 1    | 0    |      |      |      | 1    | 1    | 1    |                        | 14/16 duty  |
| 1    | 0    |      |      | 0    |      |      |      | Display on/off         | Display off |
| 1    | 0    |      |      | 1    |      |      |      |                        | Display on  |

### 3.3.4 Command Timing Diagrams

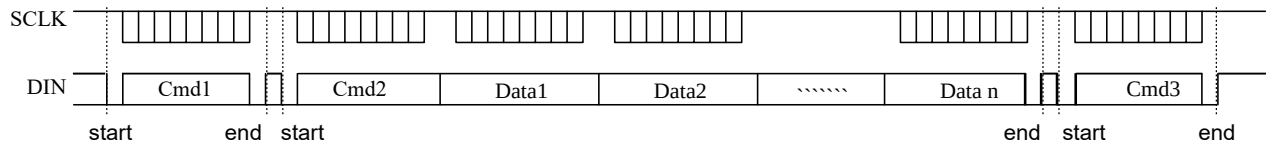
Write command or display data



## 4 Command application

### 4.1 Send Display data(Address auto Increment)

Using the address auto-increase mode, First set the starting address of the data to be transmitted (Display RAM address). After the start address command byte is sent, the display data is directly transmitted, up to 16 bytes.



Cmd1: Data Write Set Cmd -Set address auto-increase mode (0x40)

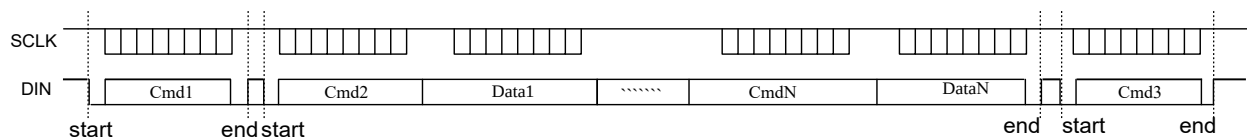
Cmd2: Address Set Cmd -Set the start address of the display RAM (0xc0-0xcf)

Data1-Datan: Send display data to the start address set by CMD3 and the subsequent address (up to 16 bytes)

Cmd3: Display Control Cmd -Display ON and select the Display brightness

### 4.2 Send Display data(Fixed Address)

Using the fixed address mode, first set the address of the data to be transmitted (Display RAM address), After sending the address, directly transmit 1 byte of display data; Then transfer the address of the next display data, and directly transfer 1 byte of display data Until the last byte of display data is transmitted, Up to 16 bytes.



Cmd1: Data Write Set Cmd -Set fixed address mode (0x44)

Cmd2: Address Set Cmd -Set Display RAM address (0xC0-0xCF)

Data1: Send the Display data to the display RAM address set by Cmd2

CmdN: Address Set Cmd -Set Display RAM address (0xC0-0xCF)

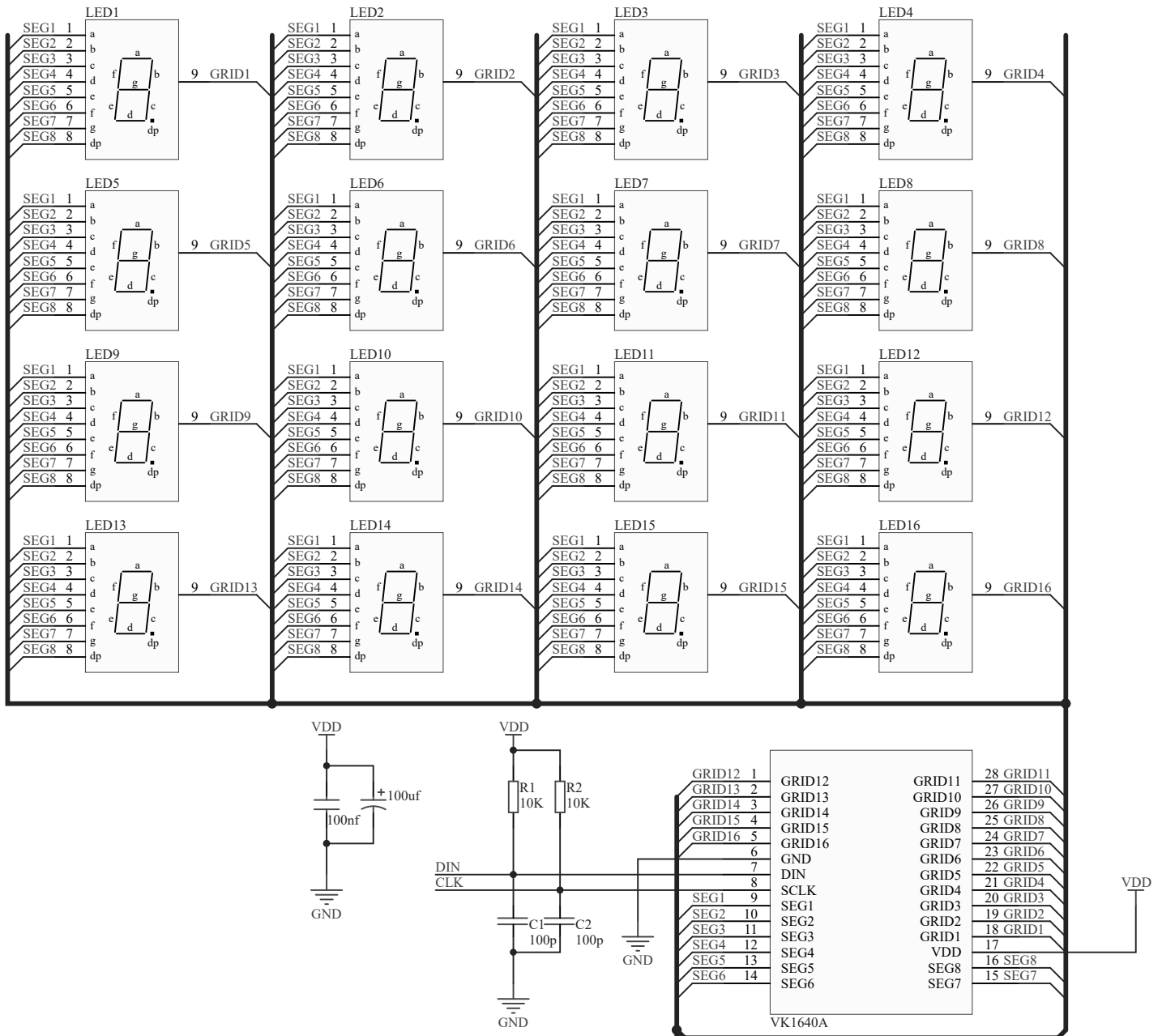
DataN: Send the Display data to the display RAM address set by CmdN

....up to 16 bytes of data to be send

Cmd3: Display Control Cmd -Display ON and select the Display brightness

## 5 Application Circuits

### 8-SEG LED Display shared Cathode



## 6 Hohfwulfdo fkdudfwhulwlfv

### 6.1 Absolute Maximum Ratings

| Item                  | Symbol              | Ratings         | Unit |
|-----------------------|---------------------|-----------------|------|
| Power voltage         | VDD                 | -0.5~6.0        | V    |
| Input Voltage         | VIN                 | VSS-0.5~VDD+0.5 | V    |
| Power Dissipation     | PD                  | 400             | mW   |
| Drive Output Current  | I <sub>OLGRID</sub> | +200            | mA   |
|                       | I <sub>OHSEG</sub>  | -50             | mA   |
| Storage Temperature   | T <sub>STG</sub>    | -65~+150        | °C   |
| Operating Temperature | T <sub>OTG</sub>    | -40~+85         | °C   |

### 6.2 DC Characteristics

| Item                      | Symbol              | Min. | Typ. | Max. | Unit | Test Conditions |                          |
|---------------------------|---------------------|------|------|------|------|-----------------|--------------------------|
|                           |                     |      |      |      |      | VDD             | Conditions               |
| Operating Voltage         | VDD                 | 3.0  | —    | 5.5  | V    | —               | —                        |
| Quiescent Current         | I <sub>DD</sub>     | —    | —    | 0.1  | mA   | 5V              | No load/LED OFF          |
| High Level output Current | I <sub>OH1</sub>    | -20  | -25  | -40  | mA   | 5V              | VO=VDD-2V<br>SEG1~SEG8   |
|                           | I <sub>OH2</sub>    | -20  | -30  | -50  |      |                 | VO=VDD-3V<br>SEG1~SEG8   |
| Low Level input Current   | I <sub>OLGRID</sub> | 80   | 140  | —    | mA   | 5V              | VO=0.3V<br>GRID1- GRID16 |
| Input Low Voltage         | V <sub>IL</sub>     | 0    | —    | 0.3  | VDD  | VDD             | SCLK, DIN                |
| Input High Voltage        | V <sub>IH</sub>     | 0.7  | —    | 1.0  |      | VDD             |                          |
| Hysteresis Voltage        | V <sub>H</sub>      | —    | 0.35 | —    | V    | 5V              | SCLK, DIN                |

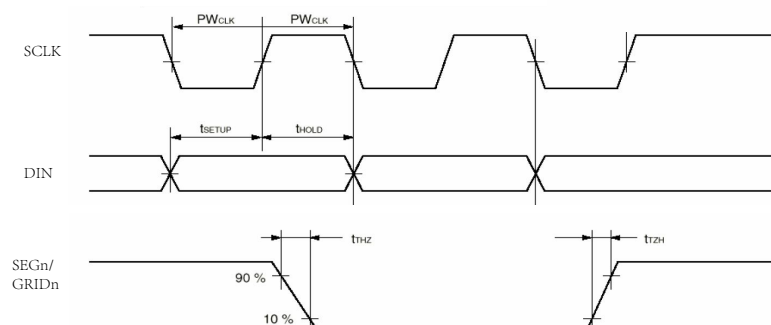
## 6.3 AC Characteristics

### Switch Parameters

| Item                    | Symbol     | Min. | Typ. | Max. | Unit | Test Conditions                    |
|-------------------------|------------|------|------|------|------|------------------------------------|
| oscillation frequency   | $F_{osc}$  | -    | 500  | -    | KHz  |                                    |
| Transmission delay time | $t_{PLZ}$  | -    | -    | 300  | nS   | CLK → DOUT                         |
|                         | $t_{PZL}$  | -    | -    | 100  | nS   | CL = 15pF, RL = 10K Ω              |
| Rise Time               | $t_{ZH1}$  | -    | -    | 2    | μS   | CL=300pF SEG1-SEG16<br>GRID1-GRID8 |
|                         | $t_{TZH2}$ | -    | -    | 0.5  | μS   | CL=300pF GRID1-GRID8               |
| Fall Time               | $t_{THZ}$  | -    | -    | 120  | μS   | CL = 300pF SEGn, GRIDn             |
| Max. input Freq         | $F_{MAX}$  | -    | -    | 1    | MHz  | Duty50%                            |
| Input Capacitance       | $C_i$      | -    | -    | 15   | pF   | -                                  |

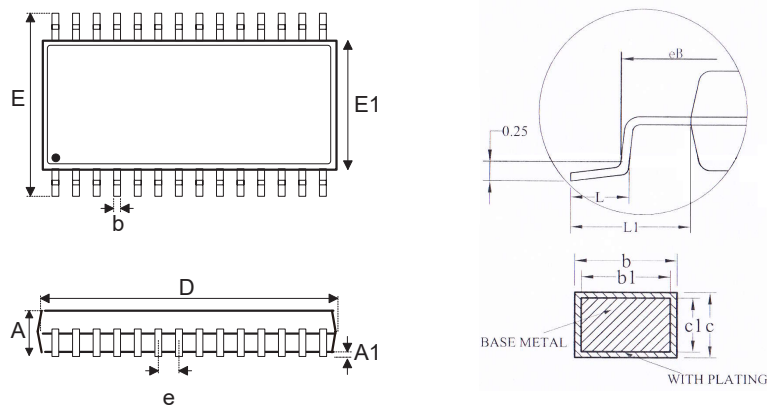
### Timing Parameters

| Item              | Symbol      | Min. | Typ. | Max. | Unit | Test Conditions |
|-------------------|-------------|------|------|------|------|-----------------|
| Clock pulse width | $PW_{CLK}$  | 400  | -    | -    | nS   | -               |
| Data Setup Time   | $t_{SETUP}$ | 100  | -    | -    | nS   | -               |
| Data Hold Time    | $t_{HOLD}$  | 100  | -    | -    | nS   | -               |
| Wait Time         | $T_{wait}$  | 1    | -    | -    | μS   | CLK ↑ → CLK ↓   |



## 7 Package Information

### 7.1 SSOP28(150mil) (9.9mm x 3.9mm PP=0.635mm)



| SYMBOL | MILLIMETER |      |       |
|--------|------------|------|-------|
|        | MIN        | NOM  | MAX   |
| A      | —          | —    | 1.75  |
| A1     | 0.05       | —    | 0.225 |
| b      | 0.23       | —    | 0.31  |
| b1     | 0.22       | 0.25 | 0.28  |
| c      | 0.20       | —    | 0.24  |
| c1     | 0.19       | 0.20 | 0.21  |
| D      | 9.80       | 9.90 | 10.00 |
| E      | 5.80       | 6.00 | 6.20  |
| E1     | 3.80       | 3.90 | 4.00  |
| e      | 0.635BSC   |      |       |
| L      | 0.75       | —    | 1.05  |
| L1     | 1.05REF    |      |       |
| θ      | 0          | —    | 8°    |

## 8 Revision history

| No. | Version | Date       | Modify the content | Check |
|-----|---------|------------|--------------------|-------|
| 1   | 1.0     | 2018-08-10 | Original version   | Yes   |
| 2   | 1.1     | 2019-07-11 | Add Ref circuits   | Yes   |
| 3   | 1.2     | 2020-02-11 | Update content     | Yes   |
|     |         |            |                    |       |

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