

## DESCRIPTION

PT6961 is an LED Controller driven on a 1/7 to 1/8 duty factor. 11 segment output lines, 6 grid output lines, 1 segment/grid output lines, one display memory, control circuit, key scan circuit are all incorporated into a single chip to build a highly reliable peripheral device for a single chip microcomputer. Serial data is fed to PT6961 via a four-line serial interface. Housed in a 32-pin SOP, PT6961 pin assignments and application circuit are optimized for easy PCB Layout and cost saving advantages.

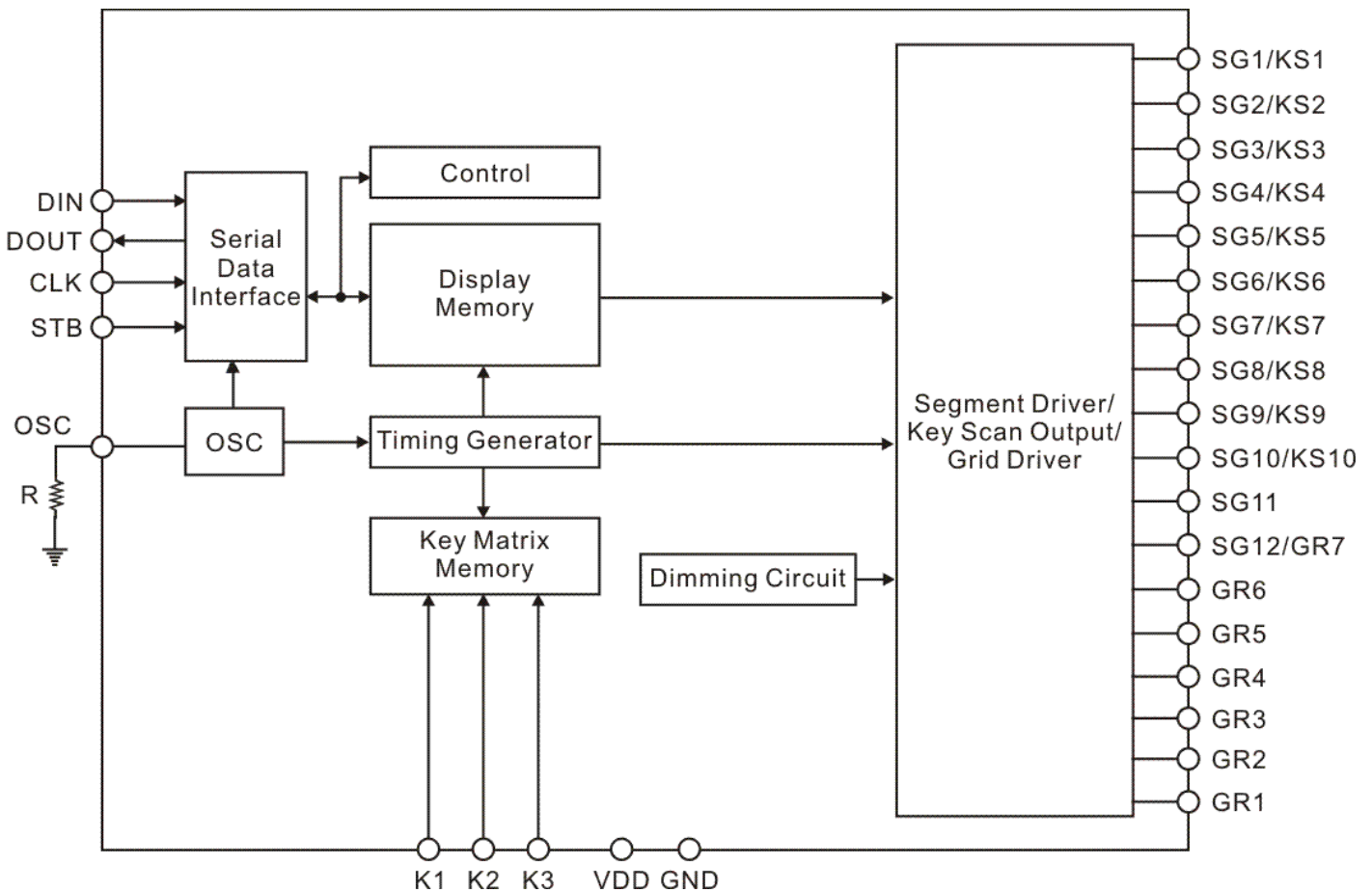
## FEATURES

- CMOS technology
- Low power consumption
- Multiple display modes (12 segments, 6 grids to 11 segments, 7 grids)
- Key scanning (10 x 3 Matrix)
- 8-Step dimming circuitry
- Serial interface for Clock, Data Input, Data Output, Strobe Pins
- Available in 32-pin, SOP

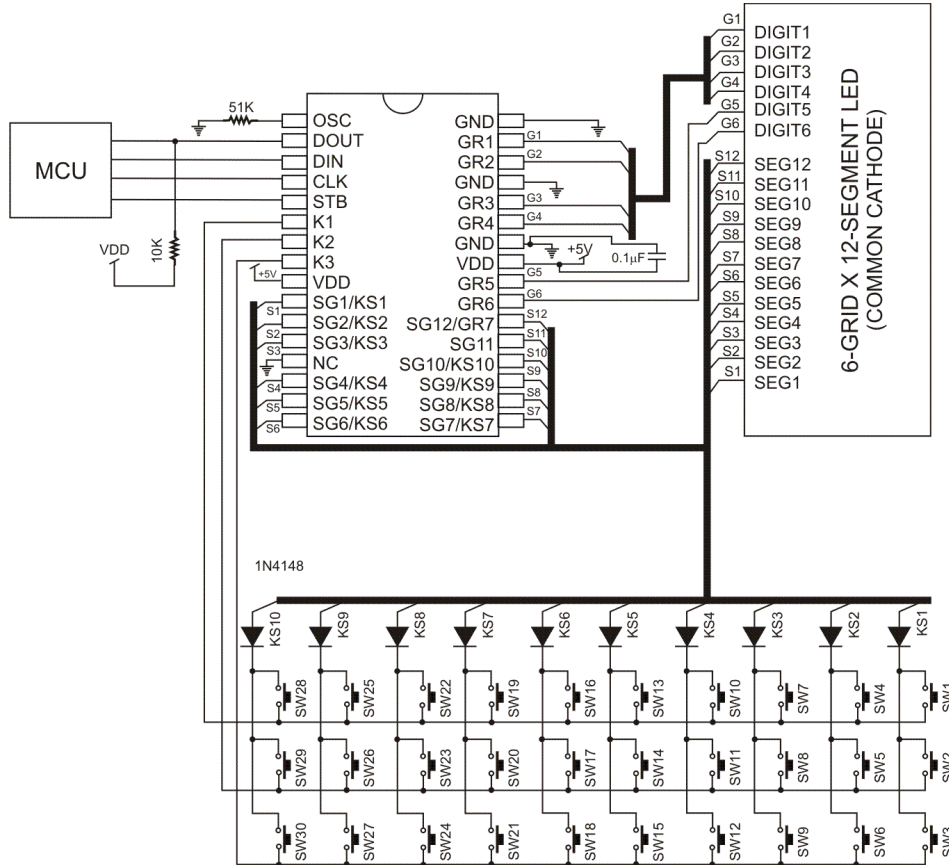
## APPLICATIONS

- Micro-computer Peripheral Device
- VCR set
- Combo set

## BLOCK DIAGRAM



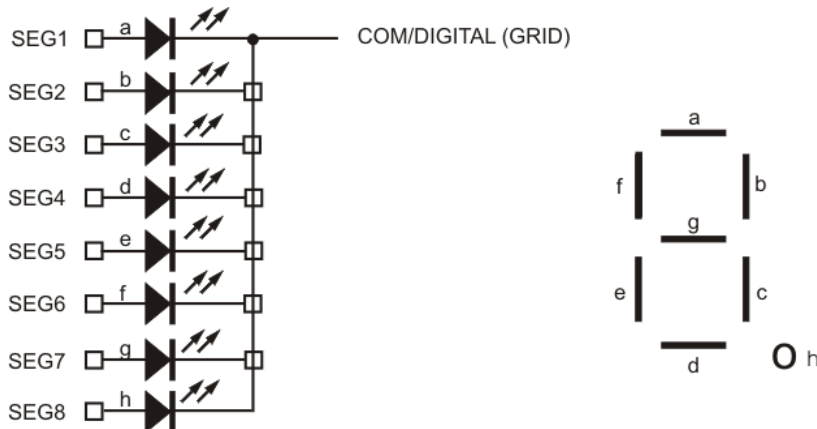
# APPLICATION CIRCUIT



**Notes:**

1. The capacitor (0.1µF) connected between the GND and the VDD pins must be located as close as possible to the PT6961 chip.
2. It is strongly suggested that the NC pin (pins 13) be connected to the GND.
3. The PT6961 power supply is separate from the application system power supply.

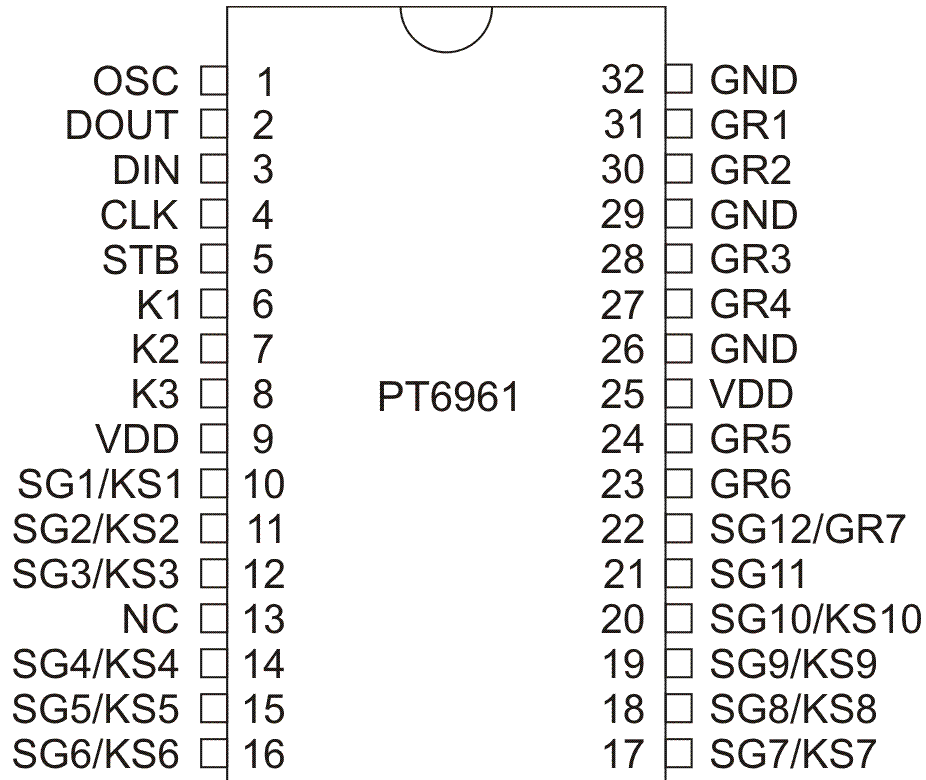
## COMMON CATHODE TYPE LED PANEL



## ORDER INFORMATION

| Valid Part Number | Package Type        | Top Code |
|-------------------|---------------------|----------|
| PT6961            | 32pins, SOP, 300mil | PT6961   |

## PIN DESCRIPTION



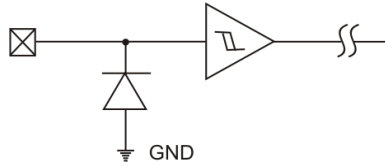
## PIN DESCRIPTION

| Pin Name            | I/O | Description  | Pin No.                   |
|---------------------|-----|--|---------------------------|
| OSC                 | I   | Oscillator Input Pin<br>A resistor is connected to this pin to determine the oscillation frequency   | 1                         |
| DOUT                | O   | Data Output Pin (N-Channel, Open-Drain)<br>This pin outputs serial data at the falling edge of the shift clock.                            | 2                         |
| DIN                 | I   | Data Input Pin<br>This pin inputs serial data at the rising edge of the shift clock (starting from the lower bit)                          | 3                         |
| CLK                 | I   | Clock Input Pin This pin reads serial data at the rising edge and outputs data at the falling edge.  | 4                         |
| STB                 | I   | Serial Interface Strobe Pin<br>The data input after the STB has fallen is processed as a command. When this pin is "HIGH", CLK is ignored. | 5                         |
| K1 ~ K3             | I   | Key Data Input Pins<br>The data sent to these pins are latched at the end of the display cycle. (Internal Pull-Low Resistor)               | 6, 7, 8                   |
| VDD                 | -   | Power Supply   | 9, 25                     |
| SG1/KS1 ~ SG10/KS10 | O   | Segment Output Pins (p-channel, open drain)<br>Also acts as the Key Source   | 10 ~ 12<br>14 ~ 20        |
| NC                  | -   | No Connection  | 13                        |
| SG11                | O   | Segment Output pins (P-Channel, open drain)  | 21                        |
| SG12/GR7            | O   | Segment / Grid Output Pins   | 22                        |
| GR6 ~ GR1           | O   | Grid Output Pins   | 23, 24, 27,<br>28, 30, 31 |
| GND                 | -   | Ground Pin   | 26, 29, 32                |

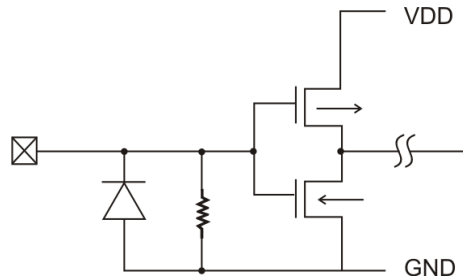
# INPUT/OUTPUT CONFIGURATIONS

The schematic diagrams of the input and output circuits of the logic section are shown below.

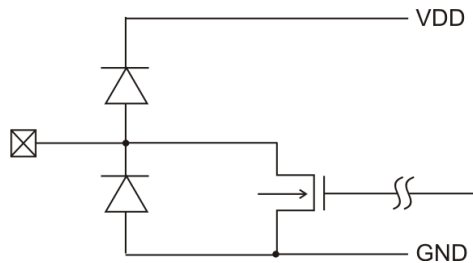
## INPUT PINS: CLK, STB & DIN



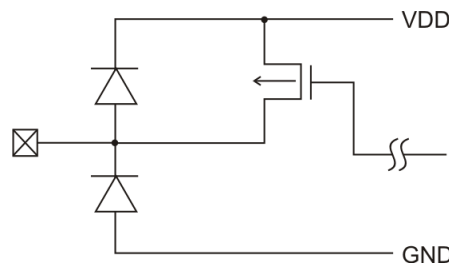
## OUTPUT PINS: K1 TO K3



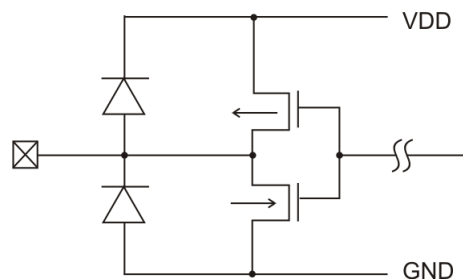
## OUTPUT PINS: DOUT, GR1 TO GR4



## OUTPUT PINS: SG1 TO SG11



## OUTPUT PINS: GR5, GR6 AND SG12/GR7



# FUNCTION DESCRIPTION

## COMMANDS

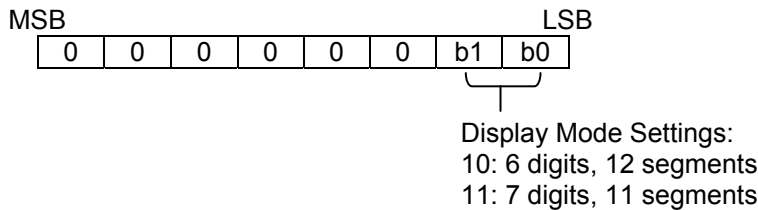
A command is the first byte (b0 to b7) inputted to PT6961 via the DIN Pin after STB Pin has changed from HIGH to LOW State. If for some reason the STB Pin is set to HIGH while data or commands are being transmitted, the serial communication is initialized, and the data/commands being transmitted are considered invalid.

### COMMANDS 1: DISPLAY MODE SETTING COMMANDS

PT6961 provides 2 display mode settings as shown in the diagram below: As stated earlier a command is the first one byte (b0 to b7) transmitted to PT6961 via the DIN Pin when STB is LOW. However, for these commands, the bit 3 & bit 8 (b2 to b7) are given a value of 0.

The Display Mode Setting Commands determine the number of segments and grids to be used (12 to 11 segments, 6 to 7 grids). A display command ON must be executed in order to resume display. If the same mode setting is selected, no command execution is take place, therefore, nothing happens.

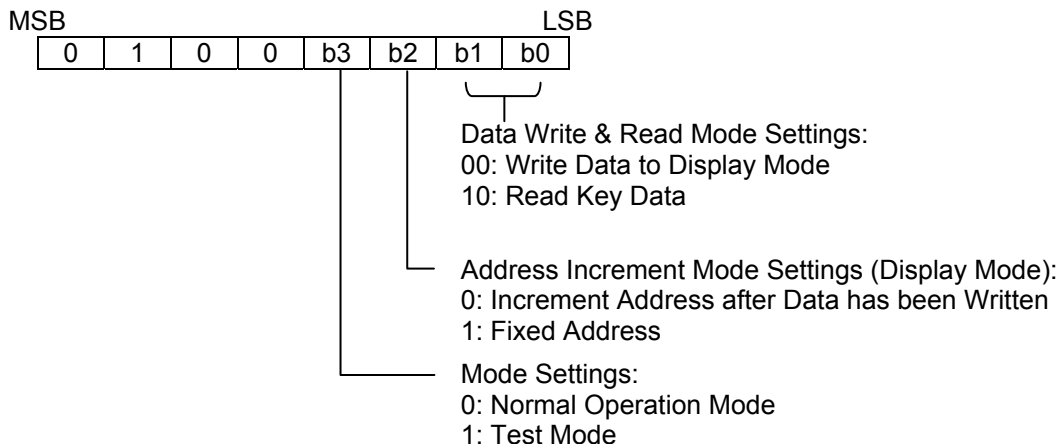
When Power is turned ON, the 7-grid, 11-segment modes is selected.



### COMMANDS 2: DATA SETTING COMMANDS

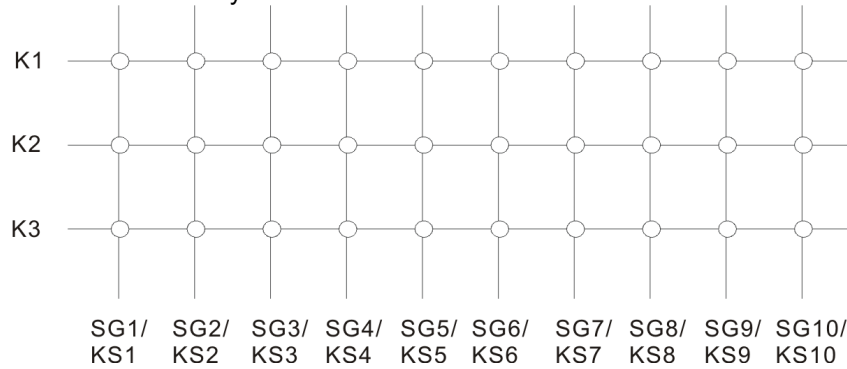
The Data Setting Commands executes the Data Write or Data Read Modes for PT6961. The data Setting Command, the bits 5 and 6 (b4, b5) are given the value of 0, bit 7 (b6) is given the value of 1 while bit 8 (b7) is given the value of 0. Please refer to the diagram below.

When power is turned ON, bit 4 to bit 1 (b3 to b0) are given the value of 0.

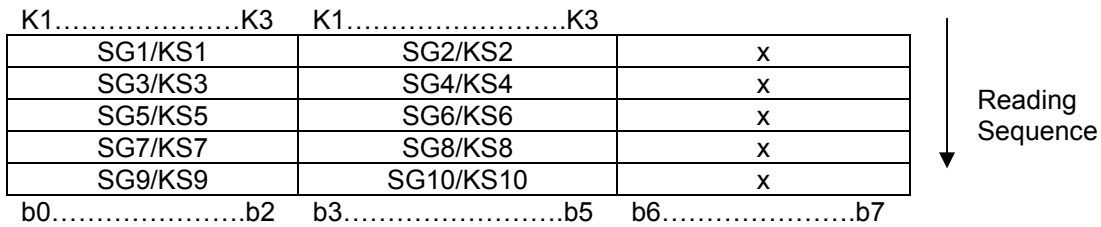


**PT6961 KEY MATRIX & KEY INPUT DATA STORAGE RAM**

PT6961 Key Matrix consists of 10 x 3 array as shown below:



Each data entered by each key is stored as follows and read by a READ Command, starting from the last significant bit. When the most significant bit of the data (b7) has been read, the least significant bit of the next data (b0) is read.

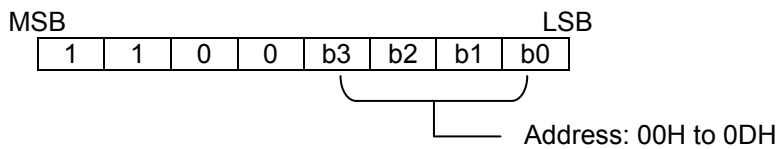


Note: b6 and b7 do not care.

**COMMANDS 3: ADDRESS SETTING COMMANDS**

Address Setting Commands are used to set the address of the display memory. The address is considered valid if it has a value of 00H to 0DH. If the address is set to 0EH or higher, the data is ignored until a valid address is set. When power is turned ON, the address is set at 00H.

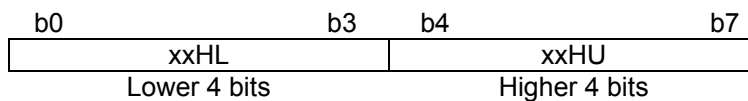
Please refer to the diagram below.



**DISPLAY MODE AND RAM ADDRESS**

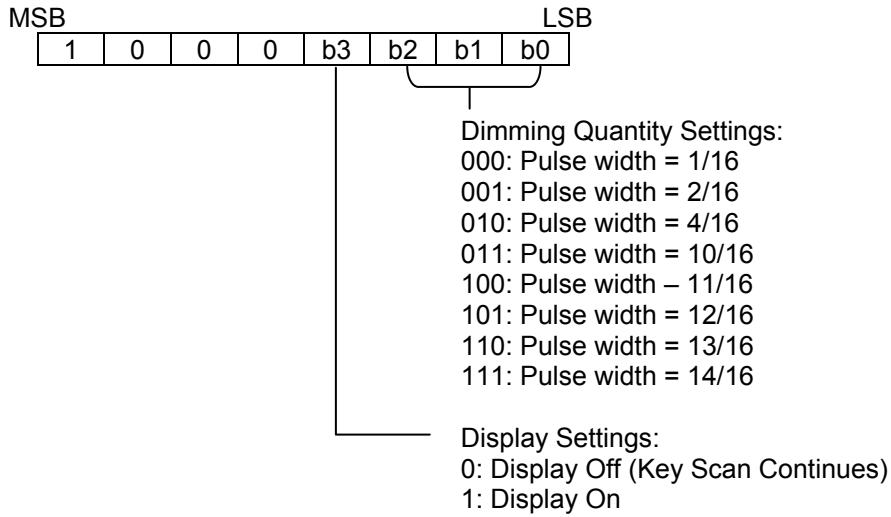
Data transmitted from an external device to PT6961 via the serial interface are stored in the Display RAM and are assigned addresses. The RAM addresses of PT6961 are given below in 8 bits unit.

|      |      |      |      |      |      |      |      |  |
|------|------|------|------|------|------|------|------|--|
| SG1  | SG4  | SG5  | SG8  | SG9  | SG12 | SG13 | SG14 |  |
| 00HL | 00HU | 01HL | 01HU | DIG1 |      |      |      |  |
| 02HL | 02HU | 03HL | 03HU | DIG2 |      |      |      |  |
| 04HL | 04HU | 05HL | 05HU | DIG3 |      |      |      |  |
| 06HL | 06HU | 07HL | 07HU | DIG4 |      |      |      |  |
| 08HL | 08HU | 09HL | 09HU | DIG5 |      |      |      |  |
| 0AHL | 0AHU | 0BHL | 0BHU | DIG6 |      |      |      |  |
| 0CHL | 0CHU | 0DHL | 0DHU | DIG7 |      |      |      |  |



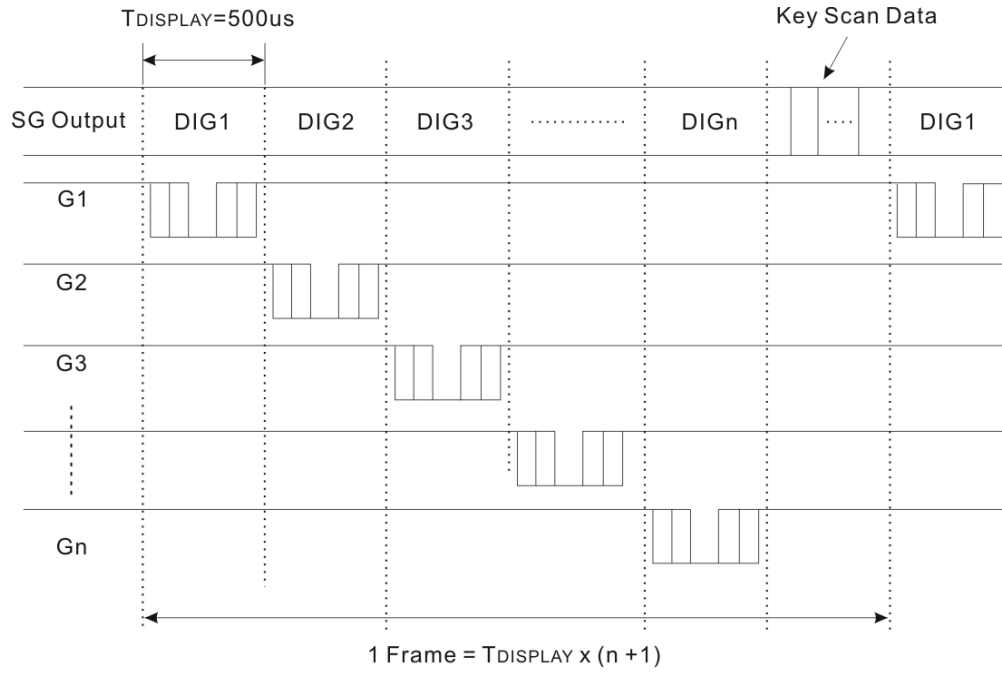
## COMMAND 4: DISPLAY CONTROL COMMANDS

The Display Control Commands are used to turn ON or OFF a display. It also used to set the pulse width. Please refer to the diagram below. When the power is turned ON, a 1/16 pulse width is selected and the displayed is turned OFF (the key scanning is started).





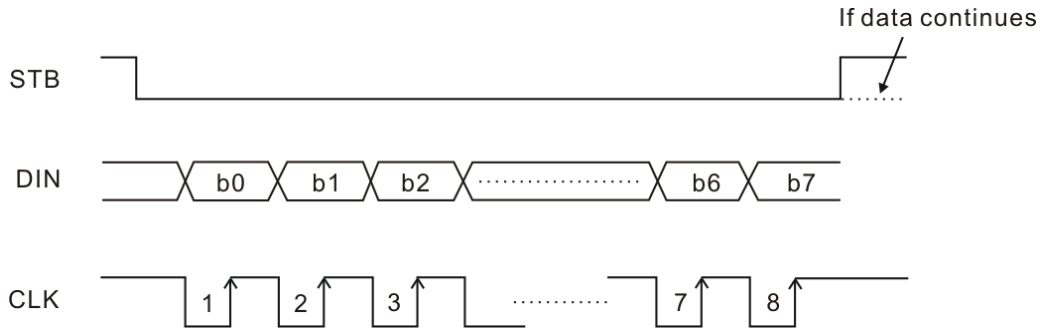
# SCANNING AND DISPLAY TIMING



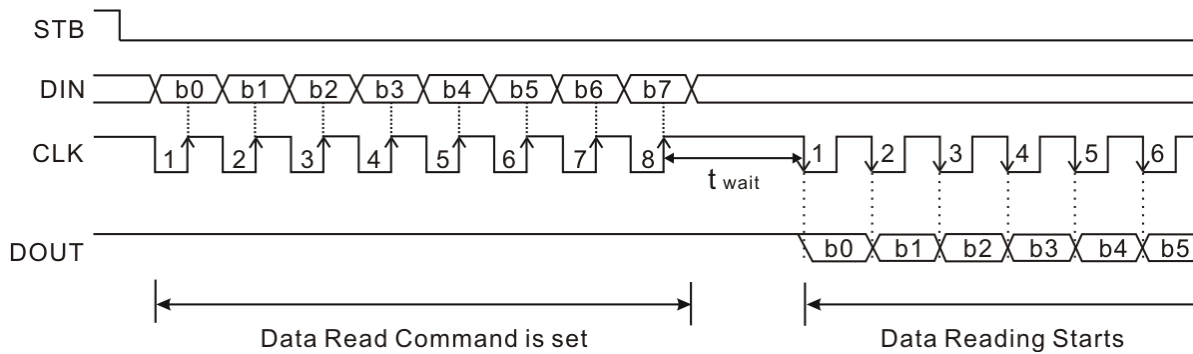
# SERIAL COMMUNICATION FORMAT

The following diagram shows the PT6961 serial communication format. The DOUT Pin is an N-channel, open-drain output pin; therefore, it is highly recommended that an external pull-up resistor (1 K $\Omega$  to 10 K $\Omega$ ) must be connected to DOUT.

## RECEPTION (DATA/COMMAND WRITE)



## TRANSMISSION (DATA READ)

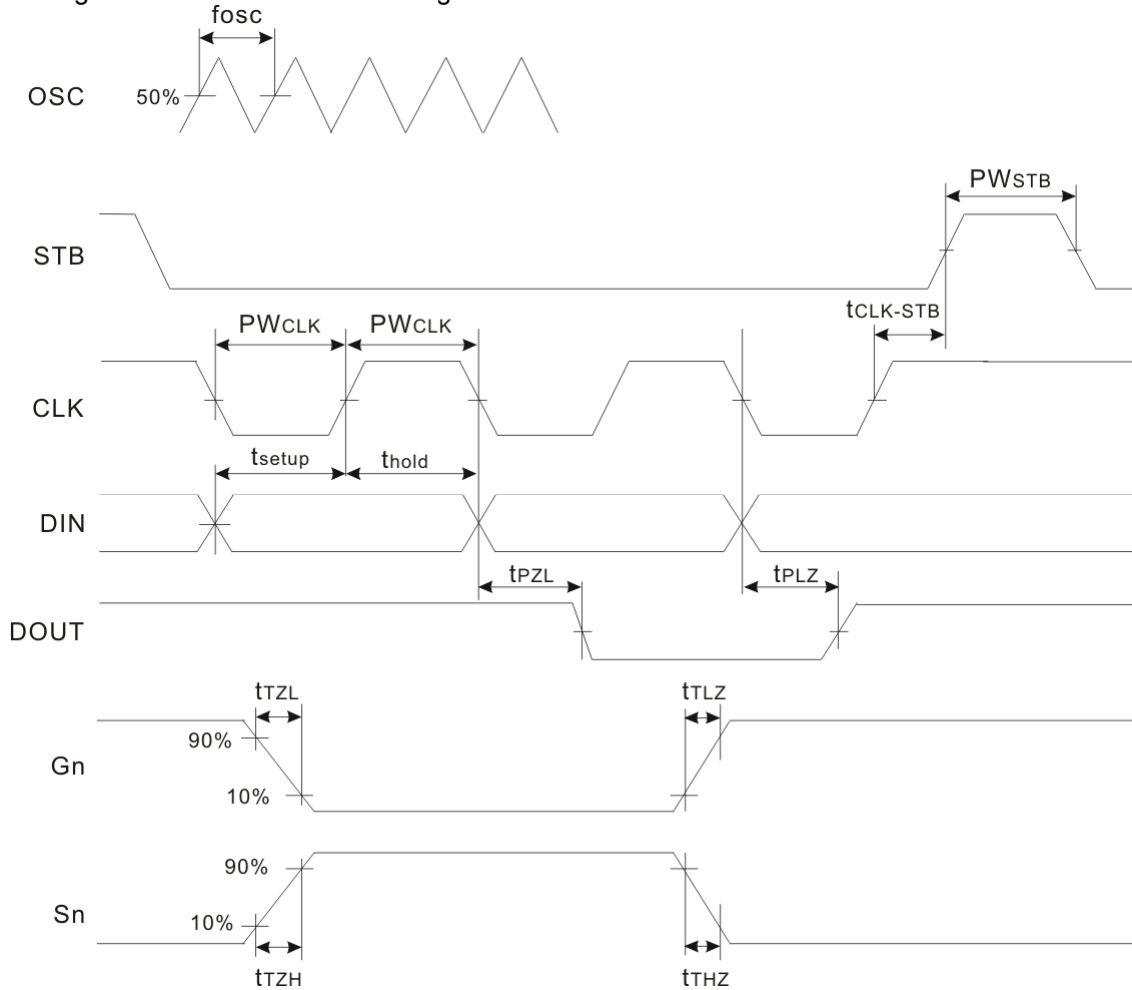


where:  $t_{wait}$  (waiting time)  $\geq 1\mu s$

It must be noted that when the data is read, the waiting time ( $t_{wait}$ ) between the rising of the eighth clock that has set the command and the falling of the first clock that has read the data is greater or equal to 1 $\mu s$ .

# SWITCHING CHARACTERISTIC WAVEFORM

PT6961 Switching Characteristics Waveform is given below.



where:

$PW_{CLK}$  (Clock Pulse Width)  $\geq 400ns$   
 $t_{setup}$  (Data Setup Time)  $\geq 100ns$   
 $t_{CLK-STB}$  (Clock – Strobe Time)  $\geq 1\mu s$   
 $t_{TZH}$  (Rise Time)  $\leq 1\mu s$   
 $f_{osc}$  = Oscillation Frequency  
 $t_{TZL} \leq 1\mu s$

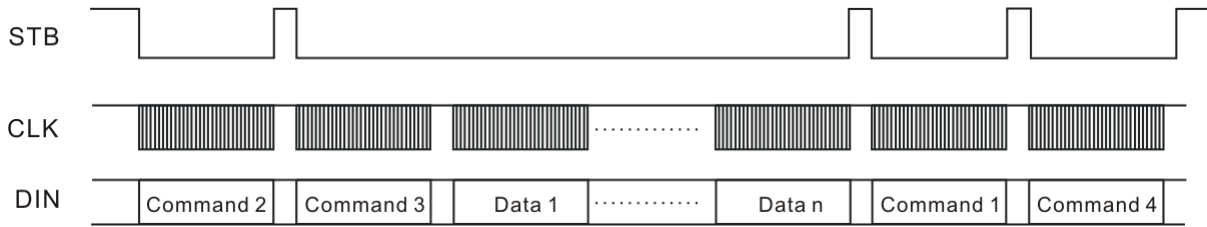
$PW_{STB}$  (Strobe Pulse Width)  $\geq 1\mu s$   
 $t_{hold}$  (Data Hold Time)  $\geq 100ns$   
 $t_{THZ}$  (Fall Time)  $\leq 10\mu s$   
 $t_{PZL}$  (Propagation Delay Time)  $\leq 100ns$   
 $t_{PLZ}$  (Propagation Delay Time)  $\leq 300ns$   
 $t_{TLZ} \leq 10\mu s$

Note:

Test Condition Under  
 $t_{THZ}$  (Pull low resistor) = 10K $\Omega$ , Loading capacitor = 300pF  
 $t_{TLZ}$  (Pull high resistor) = 10K $\Omega$ , Loading capacitor = 300pF

# APPLICATIONS

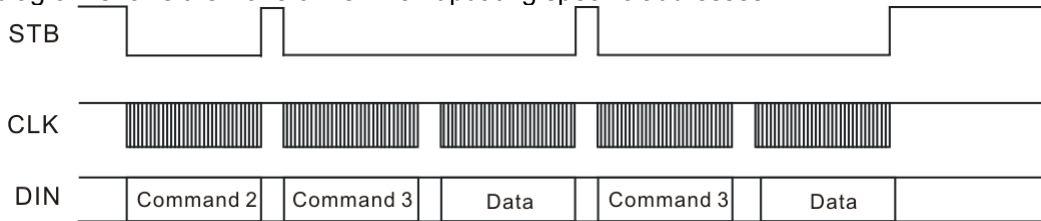
Display memory is updated by incrementing addresses. Please refer to the following diagram.



where:

- Command 1: Display mode setting command
- Command 2: Data setting command
- Command 3: Address setting command
- Data 1 to n: Transfer display data (14 bytes max.)
- Command 4: Display control command

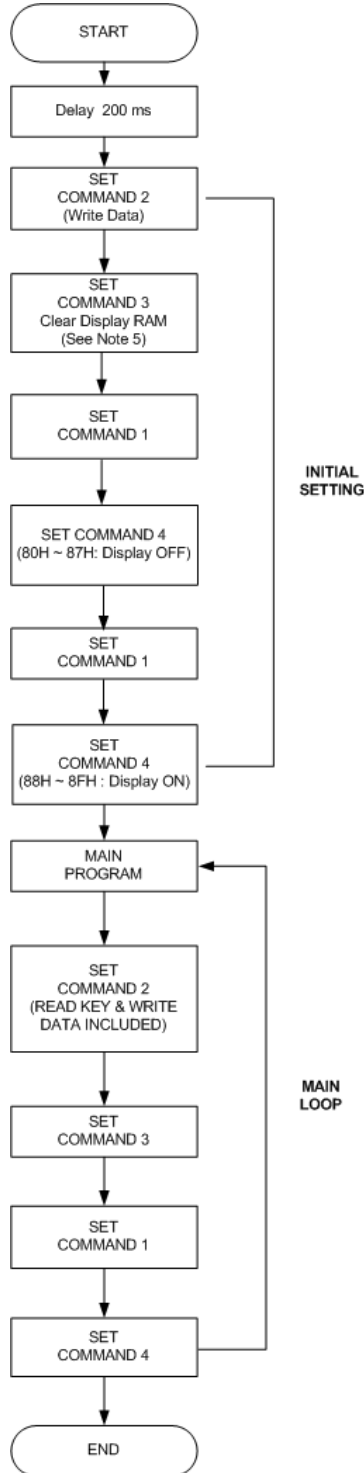
The following diagram shows the waveforms when updating specific addresses.



where:

- Command 2: Data setting command
- Command 3: Address setting command
- Data: Display data

# RECOMMENDED SOFTWARE FLOWCHART

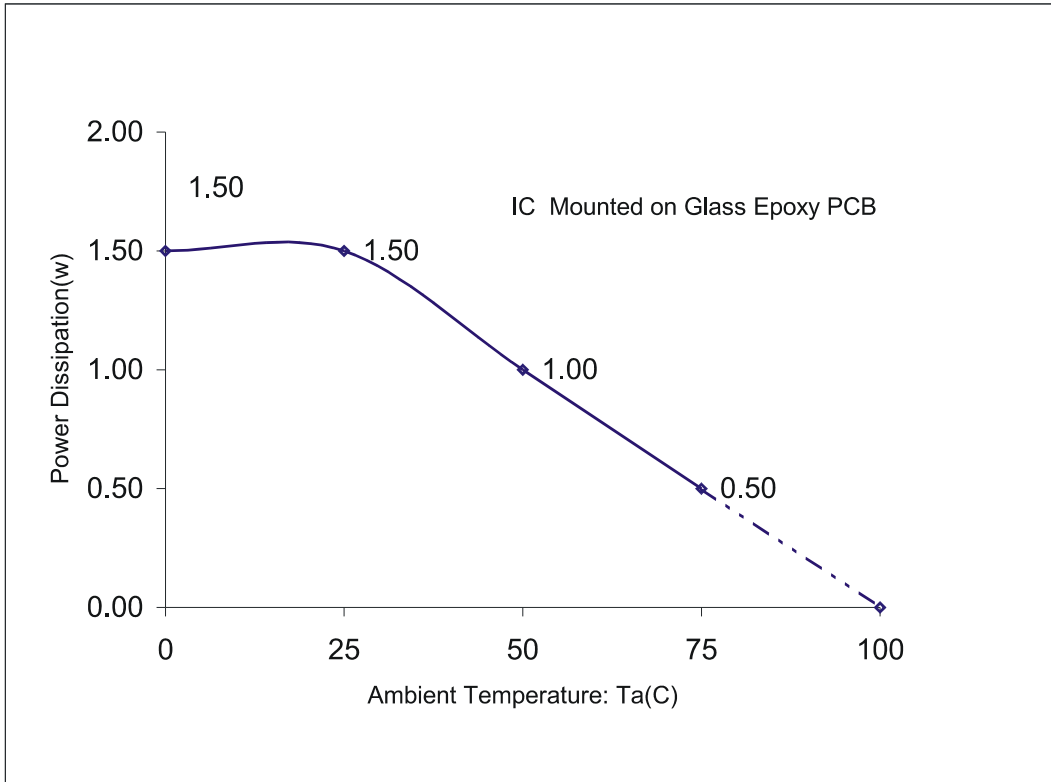


**Notes:**

1. Command 1: Display Mode Commands
2. Command 2: Data Setting Commands
3. Command 3: Address Setting Commands
4. Command 4: Display Control Commands
5. When IC power is applied for the first time, the contents of the Display RAM are not defined; thus, it is strongly suggested that the contents of the Display RAM be cleared during the initial setting.

# SOP 32 (300MIL) THERMAL PERFORMANCE IN STILL AIR

## JUNCTION TEMPERATURE: 100 °C



## ABSOLUTE MAXIMUM RATINGS

(Unless otherwise specified, Ta=25°C, GND=0V)

| Parameter                           | Symbol | Ratings         | Unit |
|-------------------------------------|--------|-----------------|------|
| Supply voltage                      | VDD    | -0.5 to +7      | V    |
| Logic input voltage                 | VI     | -0.5 to VDD+0.5 | V    |
| Driver output current               | IOLGR  | +250            | mA   |
|                                     | IOHSG  | -50             | mA   |
| Maximum driver output current/total | ITOTAL | 400             | mA   |
| Operating temperature               | Topr   | -40 ~ +85       | °C   |
| Storage temperature                 | Tstg   | -65 ~ +150      | °C   |

## RECOMMENDED OPERATING RANGE

(Unless otherwise specified, Topr=25°C, GND=0V)

| Parameter                  | Symbol | Condition | Min.    | Typ. | Max.    | Unit |
|----------------------------|--------|-----------|---------|------|---------|------|
| Logic supply voltage       | VDD    | VDD       | 3       | 5    | 5.5     | V    |
| Dynamic current (see Note) | IDDdyn | VDD       | -       | -    | 5       | mA   |
| High-level input voltage   | VIH    | VDD=5V    | 0.8 VDD | -    | VDD     | V    |
|                            |        | VDD=3V    | 0.8 VDD | -    | VDD     |      |
| Low-level input voltage    | VIL    | VDD=5V    | 0       | -    | 0.3 VDD | V    |
|                            |        | VDD=3V    | 0       | -    | 0.3     |      |

Note: Test Condition: Set Display Control Commands = 80H (Display Turn OFF State & under no load)

# ELECTRICAL CHARACTERISTICS

(Unless otherwise stated, VDD =5V, GND=0V, Ta=25°C)

| Parameter                                   | Symbol   | Test Condition                       | Min.   | Typ. | Max.   | Unit |
|---|----------|--------------------------------------|--------|------|--------|------|
| High-level output current                   | IOHSG(1) | VO= VDD -2V<br>SG1 to SG11, SG12/GR7 | -20    | -25  | -40    | mA   |
|   | IOHSG(2) | VO= VDD -3V<br>SG1 to SG11, SG12/GR7 | -25    | -30  | -50    | mA   |
| Low-level output current                    | IOLGR    | VO=0.3V<br>GR1 to GR6, SG12/GR7      | 100    | 140  | -      | mA   |
| Low-level output current                    | IOLDOUT  | VO=0.4V                              | 4      | -    | -      | mA   |
| Segment high-level output current tolerance | ITOLSG   | VO= VDD -3V<br>SG1 to SG11, SG12/GR7 | -      | -    | ±5     | %    |
| High-level input voltage                    | VIH      | -                                    | 0.8VDD | -    | 5      | V    |
| Low-level input voltage                     | VIL      | -                                    | 0      | -    | 0.3VDD | V    |
| Oscillation frequency                       | fosc     | R=51KΩ                               | 350    | 500  | 650    | KHz  |
| K1 to K3 pull down resistor                 | RKN      | K1 to K3, VDD =5V                    | 40     | -    | 100    | KΩ   |

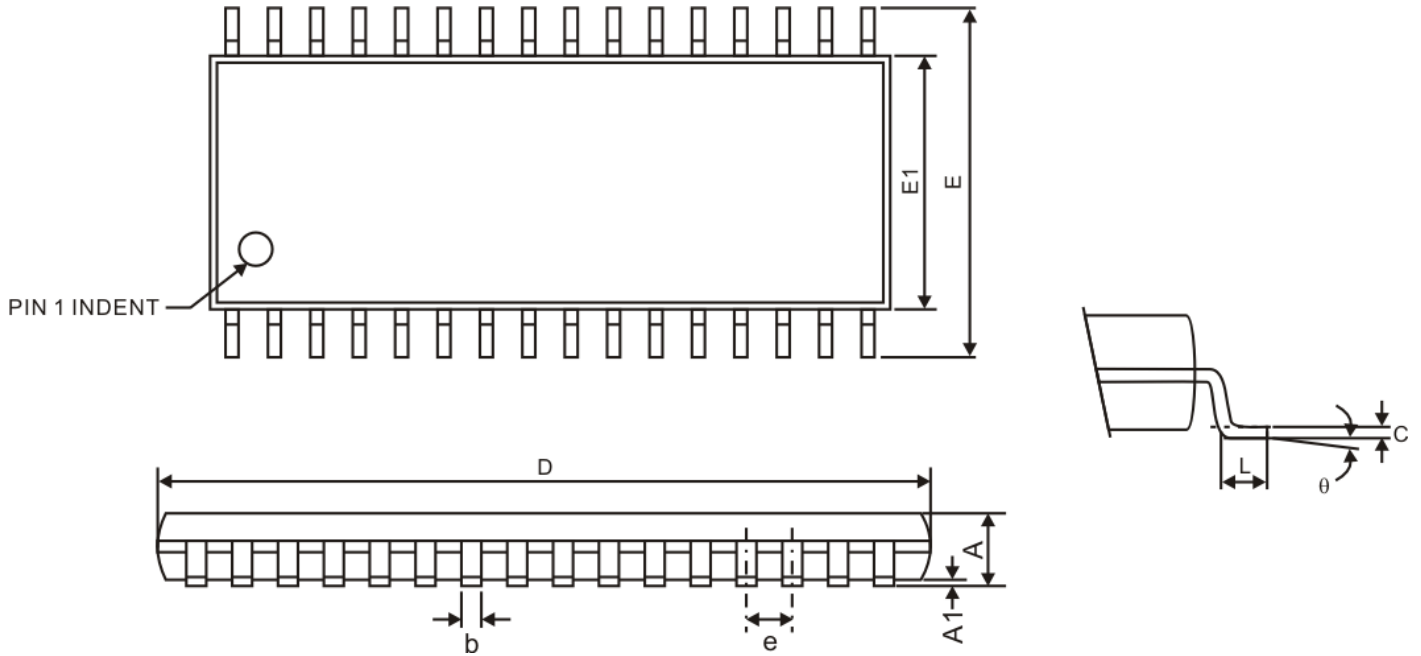
(Unless otherwise stated, VDD =3V, GND=0V, Ta=25°C)

| Parameter                                   | Symbol  | Test Condition                       | Min.   | Typ. | Max. | Unit |
|---|---------|--------------------------------------|--------|------|------|------|
| High-level output current                   | IOHSG   | VO=VDD-2V<br>SG1 to SG11, SG12/GR7   | -9     | -12  | -20  | mA   |
| Low-level output current                    | IOLGR   | VO=0.3V<br>GR1 to GR6, SG12/GR7      | 80     | 100  | -    | mA   |
| Low-level output current                    | IOLDOUT | VO=0.4V                              | 3      | -    | -    | mA   |
| Segment high-level output current tolerance | ITOLSG  | VO= VDD -2V<br>SG1 to SG11, SG12/GR7 | -      | -    | ±5   | %    |
| High-level input voltage                    | VIH     | -                                    | 0.8VDD | -    | VDD  | V    |
| Low-level input voltage                     | VIL     | -                                    | 0      | -    | 0.3  | V    |
| Oscillation frequency                       | fosc    | R=33KΩ                               | 350    | 500  | 650  | KHz  |
| K1 to K3 pull down resistor                 | RKN     | K1 to K3, VDD=3V                     | 90     | -    | 180  | KΩ   |



# PACKAGE INFORMATION

32 PINS, SOP, 300 MIL



| Symbol | Min.      | Typ. | Max.  |
|--------|-----------|------|-------|
| A      | -         | -    | 2.65  |
| A1     | 0.10      | -    | -     |
| b      | 0.31      | -    | 0.51  |
| c      | 0.20      | -    | 0.33  |
| e      | 1.27 BSC. |      |       |
| D      | 20.32     | -    | 20.73 |
| E      | 7.40      | -    | 7.60  |
| E1     | 10.00     | -    | 10.65 |
| L      | 0.38      | -    | 1.27  |
| θ      | 0         |      | 8     |

Notes:  
 1. Refer to JEDEC MO-119 AC  
 2. Unit: mm

## **IMPORTANT NOTICE**

Princeton Technology Corporation (PTC) reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and to discontinue any product without notice at any time.

PTC cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a PTC product. No circuit patent licenses are implied.

Princeton Technology Corp.  
2F, 233-1, Baociao Road,  
Sindian, Taipei 23145, Taiwan  
Tel: 886-2-66296288  
Fax: 886-2-29174598  
<http://www.princeton.com.tw>