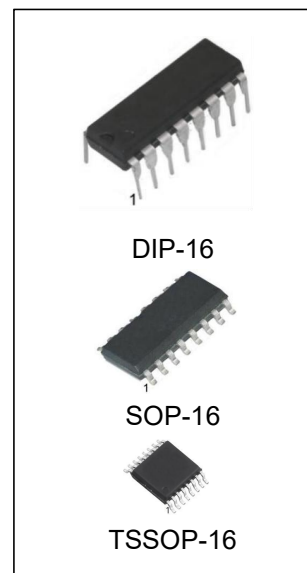


## INTERFACE TRANSCEIVER OF RS-232 STANDARD WITH ONE SUPPLY VOLTAGE

### DESCRIPTION

IC MAX232 is purposed for application in high-performance information processing systems and control devices of wide application.

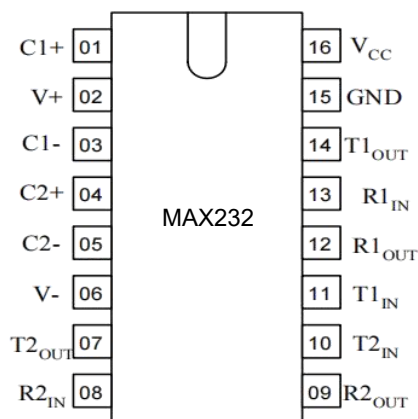
- Input voltage levels are compatible with standard CMOS levels.
- Output voltage levels are compatible with input levels of C-MOS, N-MOS and TTL integrated circuits.
- Low input current: 1.0 mA; 0.1 mA at Ta= 25°C
- Output current 24 mA.
- Latching current not less than 450 mA at Ta= 25°C
- Tolerable value of static potential not less than 2000V



### Ordering Information

| DEVICE        | Package Type | MARKING        | Packing | Packing Qty  |
|---------------|--------------|----------------|---------|--------------|
| MAX232ECN     | DIP-16       | MAX232EC,232EC | TUBE    | 1000pcs/box  |
| MAX232ECM/TR  | SOP-16       | MAX232EC,232EC | REEL    | 2500pcs/reel |
| MAX232ECMT/TR | TSSOP-16     | X232EC,232EC   | REEL    | 2500pcs/reel |
| MAX232EIN     | DIP-16       | MAX232EI,232EI | TUBE    | 1000pcs/box  |
| MAX232EIM/TR  | SOP-16       | MAX232EI,232EI | REEL    | 2500pcs/reel |
| MAX232EIMT/TR | TSSOP-16     | X232EI,232EI   | REEL    | 2500pcs/reel |

## Pin symbols in package



## Table of pin description

|    | Symbol            | Pin name                                                           |
|----|-------------------|--------------------------------------------------------------------|
| 01 | C1+               | Output of external capacitance of positive voltage multiplier unit |
| 02 | V+                | Output of positive voltage of multiplier unit                      |
| 03 | C1-               | Output of external capacitance of positive voltage multiplier unit |
| 04 | C2+               | Output of external capacitance of negative voltage multiplier unit |
| 05 | C2-               | Output of external capacitance of negative voltage multiplier unit |
| 06 | V-                | Output of negative voltage of multiplier unit                      |
| 07 | T2 <sub>OUT</sub> | Output of transmitter data (levels RS – 232)                       |
| 08 | R2 <sub>IN</sub>  | Input of receiver data (levels RS – 232)                           |
| 09 | R2 <sub>OUT</sub> | Output of receiver data (levels TTL/KMOS)                          |
| 10 | T2 <sub>IN</sub>  | Input of transmitter data (levels TTL/KMOS)                        |
| 11 | T1 <sub>IN</sub>  | Input of transmitter data (levels TTL/KMOS)                        |
| 12 | R1 <sub>OUT</sub> | Output of receiver data (levels TTL/KMOS)                          |
| 13 | R1 <sub>IN</sub>  | Input of receiver data (levels RS – 232)                           |
| 14 | T1 <sub>OUT</sub> | Output of transmitter data (levels RS – 232)                       |
| 15 | GND               | Common output                                                      |
| 16 | V <sub>CC</sub>   | Supply output of voltage source                                    |

## Truth table

| Inputs                            | Outputs                             |
|-----------------------------------|-------------------------------------|
| R <sub>IN</sub> , T <sub>IN</sub> | R <sub>OUT</sub> , T <sub>OUT</sub> |
| H                                 | L                                   |
| L                                 | H                                   |

Note -H – voltage high level; L – low voltage level

## Maximum conditions

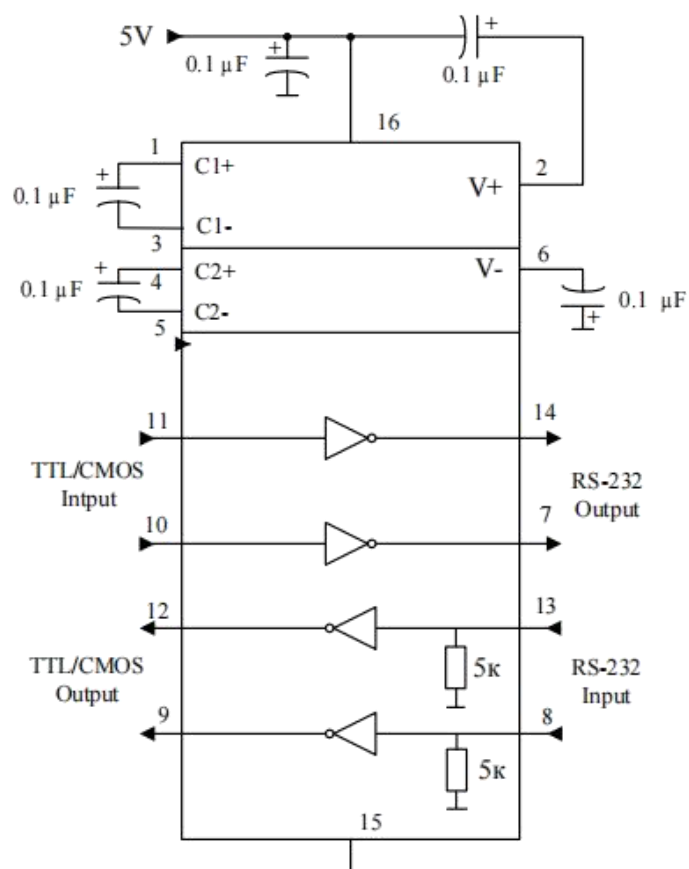
| Symbol           | Parameter                                   | Rate                 |                     | Unit |
|------------------|---------------------------------------------|----------------------|---------------------|------|
|                  |                                             | min                  | max                 |      |
| V <sub>CC</sub>  | Supply voltage                              | -0.3                 | 6.0                 | V    |
| V <sub>+</sub>   | Transmitter high output voltage             | V <sub>CC</sub> -0.3 | 14                  |      |
| V <sub>-</sub>   | Transmitter low output voltage              | -0.3                 | -14                 |      |
| V <sub>TIN</sub> | Transmitter input voltage                   | -0.3                 | V <sub>+</sub> +0.3 |      |
| V <sub>RIN</sub> | Receiver input voltage                      | -30                  | 30                  |      |
| P <sub>D</sub>   | Dissipated power                            | -                    |                     | mW   |
|                  | DIP – package                               |                      | 842                 |      |
|                  | SOP - package                               |                      | 762                 |      |
| I <sub>SC</sub>  | Output current of transmitter short circuit | -                    | Continu-ously       | mA   |
| T <sub>a</sub>   | Ambient temperature                         | -60                  | 150                 | °C   |
| T <sub>L</sub>   | Lead Temperature (Soldering, 10 seconds)    | -                    | 260                 | °C   |

**Note:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured.

## Recommended Operating Conditions

| Symbol           | Parameter                                |          | Rate |                 | Unit |
|------------------|------------------------------------------|----------|------|-----------------|------|
|                  |                                          |          | min  | max             |      |
| V <sub>CC</sub>  | Supply voltage                           |          | 4.5  | 5.5             | V    |
| V <sub>+</sub>   | Transmitter output high voltage          |          | 5.0  | -               |      |
| V <sub>-</sub>   | Transmitter output low voltage           |          | -5.0 | -               |      |
| V <sub>TIN</sub> | Transmitter input voltage                |          | 0    | V <sub>CC</sub> |      |
| V <sub>RIN</sub> | Receiver input voltage                   |          | -30  | 30              |      |
| I <sub>SC</sub>  | Transmitter short circuit output current |          | -    | ±60             | mA   |
| T <sub>a</sub>   | Ambient temperature                      | MAX232EC | 0    | 70              | °C   |
|                  |                                          | MAX232EI | -40  | 85              |      |

## Typical Application



## Electrical Characteristics

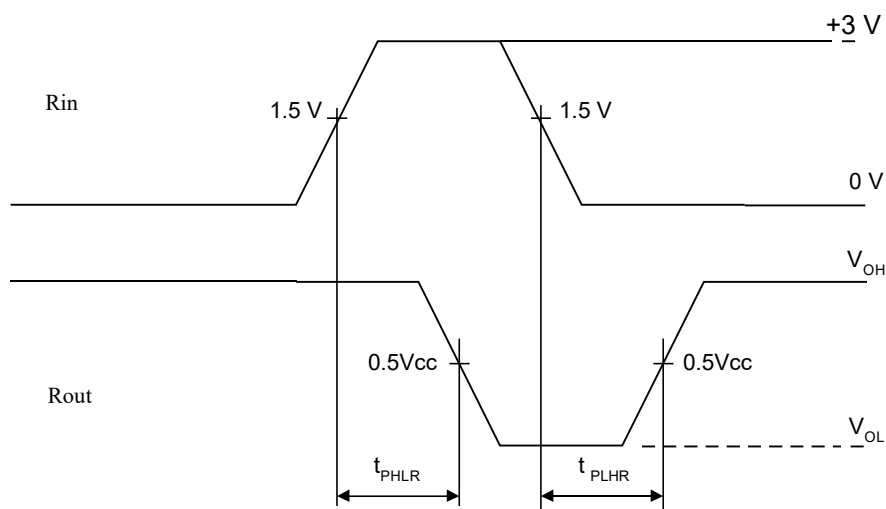
| Symbol                            | Parameter                         | Test conditions                                                                                                                              | Rate |           |               |           | Unit  |
|-----------------------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------|-----------|---------------|-----------|-------|
|                                   |                                   |                                                                                                                                              | 25°C |           | -40°C to 85°C |           |       |
|                                   |                                   |                                                                                                                                              | min  | max       | min           | max       |       |
| I <sub>CC</sub>                   | Consumption current static        | V <sub>CC</sub> =5.5 V V <sub>IL</sub> = 0 V                                                                                                 | -    | 10.0      | -             | 14.0      | mA    |
| Receiver electrical parameters    |                                   |                                                                                                                                              |      |           |               |           |       |
| V <sub>h</sub>                    | Hysteresis voltage                | V <sub>CC</sub> =5.0 V                                                                                                                       | 0.2  | 0.9       | 0.2           | 1.0       | V     |
| V <sub>On</sub>                   | On (operation) voltage            | V <sub>O</sub> ≤ 0.1 V<br>I <sub>OL</sub> ≤ 20 mA                                                                                            | -    | 2.4       | -             | 2.3       |       |
| V <sub>off</sub>                  | Off (dropout) voltage             | V <sub>O</sub> ≥ V <sub>CC</sub> -0.1 V<br>I <sub>OH</sub> ≤ 20 mA                                                                           | 0.8  | -         | 0.9           | -         |       |
| V <sub>OL</sub>                   | Output low voltage                | I <sub>OL</sub> = 3.2 mA<br>V <sub>CC</sub> = 4.5 V<br>V <sub>IH</sub> = 2.4 V                                                               | -    | 0.3       | -             | 0.4       |       |
| V <sub>OH</sub>                   | Output high voltage               | I <sub>OH</sub> = -1.0 mA<br>V <sub>CC</sub> = 4.5 V<br>V <sub>IL</sub> = 0.8 V                                                              | 3.6  | -         | 3.5           | -         |       |
| R <sub>i</sub>                    | Input resistance                  | V <sub>CC</sub> = 5.0 V                                                                                                                      | 3.0  | 7.0       | 3.0           | 7.0       | kOhm  |
| Transmitter electrical parameters |                                   |                                                                                                                                              |      |           |               |           |       |
| V <sub>OL</sub>                   | Output low voltage                | V <sub>CC</sub> = 4.5 V<br>V <sub>IH</sub> = 2.0 V<br>R <sub>L</sub> = 3.0 kOhm                                                              | -    | -5.2      | -             | -5.0      | V     |
| V <sub>OH</sub>                   | Output high voltage               | V <sub>CC</sub> = 4.5 V<br>V <sub>IL</sub> = 0.8 V<br>R <sub>L</sub> = 3.0 kOhm                                                              | 5.2  | -         | 5.0           | -         |       |
| I <sub>IL</sub>                   | Input low current                 | V <sub>CC</sub> =5.5 V<br>V <sub>IL</sub> = 0 V                                                                                              | -    | -1.0      | -             | -10.0     | mA    |
| I <sub>IH</sub>                   | Input high current                | V <sub>CC</sub> =5.5 V<br>V <sub>IH</sub> = V <sub>CC</sub>                                                                                  |      | 1.0       |               | 10.0      |       |
| SR                                | Speed of output front change      | V <sub>CC</sub> =5.0 V<br>C <sub>L</sub> =50 - 1000 pF<br>R <sub>L</sub> = 3.0 - 7.0 kOhm                                                    | 3.0  | 30        | 2.7           | 27        | V/mks |
| R <sub>O</sub>                    | Output resistance                 | V <sub>CC</sub> = V <sub>+</sub> = V <sub>-</sub> = 0V<br>V <sub>O</sub> = 2 V                                                               | 350  | -         | 300           | -         | Ohm   |
| I <sub>SC</sub>                   | Short circuit output current      | V <sub>CC</sub> =5.5 V<br>V <sub>O</sub> = 0V<br>V <sub>I</sub> = V <sub>CC</sub><br>V <sub>I</sub> = 0V                                     |      | -50<br>50 |               | -60<br>60 | mA    |
| ST                                | Speed of information transmission | V <sub>CC</sub> =4.5 V<br>C <sub>L</sub> = 1000pF<br>R <sub>L</sub> = 3.0 kOhm<br>t <sub>W</sub> = 7mks (for extreme -t <sub>W</sub> = 8mks) | 140  | -         | 120           | -         |       |

| Symbol        | Parameter                                                | Test conditions                                                                                                                                                              | Rate |      |               |      | Unit |
|---------------|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|---------------|------|------|
|               |                                                          |                                                                                                                                                                              | 25°C |      | -40°C to 85°C |      |      |
|               |                                                          |                                                                                                                                                                              | min  | max  | min           | max  |      |
| tPHLR (tPLHR) | Signal propagation delay time<br>when switching on (off) | V <sub>CC</sub> = 4.5 V<br>C <sub>L</sub> = 150 pF<br>V <sub>IL</sub> = 0 V<br>V <sub>IH</sub> = 3.0 V<br>t <sub>LH</sub> = t <sub>HL</sub> ≤ 10 ns                          | -    | 9.7  | -             | 10   | mks  |
| tPHLT (tPLHT) | Signal propagation delay time<br>when switching on (off) | V <sub>CC</sub> = 4.5 V C <sub>L</sub> =<br>2500 pF V <sub>IL</sub> = 0 V<br>V <sub>IH</sub> = 3.0 V<br>R <sub>L</sub> = 3 kOhm<br>t <sub>LH</sub> = t <sub>HL</sub> ≤ 10 ns |      | 5.0* |               | 6.0* |      |

## Capacitance

| Symbol          | Parameter           | V <sub>CC</sub> , V | Rate | Unit |
|-----------------|---------------------|---------------------|------|------|
| C <sub>IN</sub> | Input capacitance   | 5.0                 | 9.0  | pF   |
| CPD             | Dynamic capacitance |                     | 90   |      |

## Timing diagram when measuring IC dynamic parameters



**Figure 3**

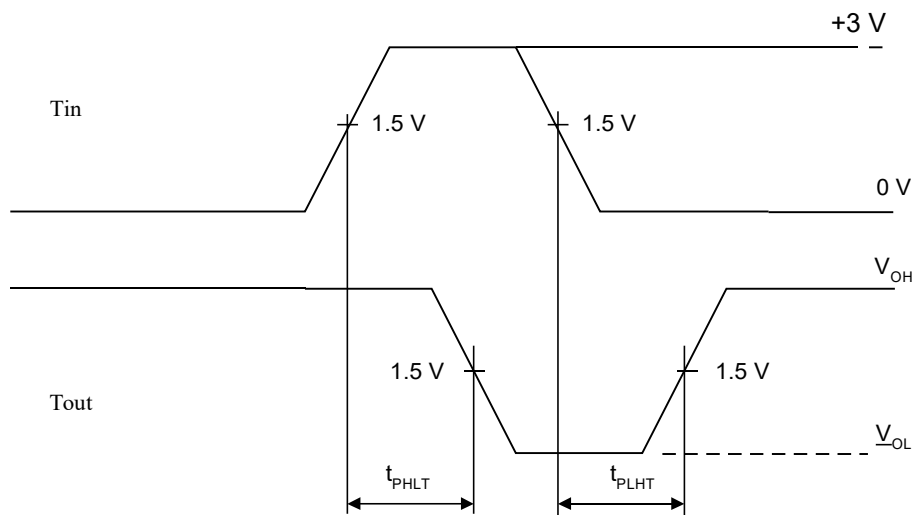


Figure 4

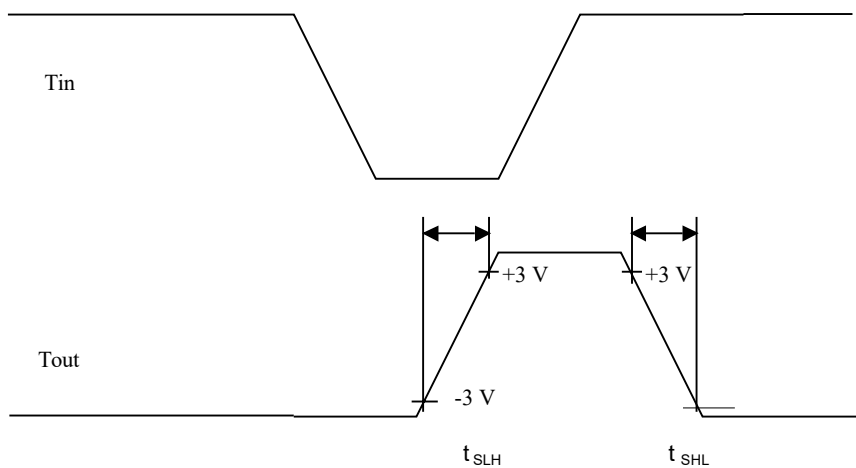


Figure 5

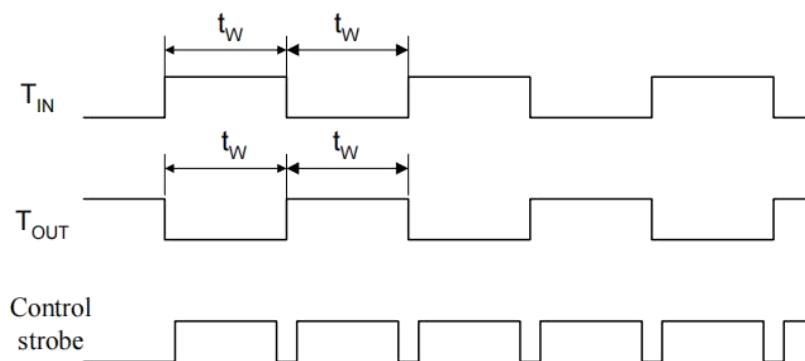
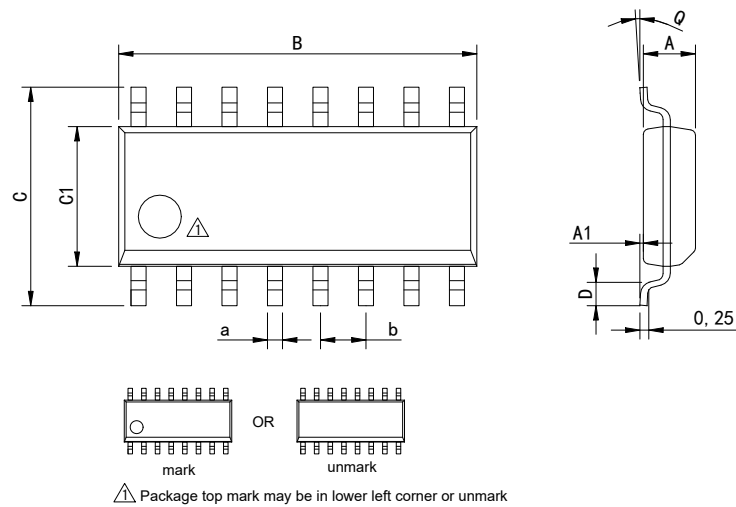


Figure 6

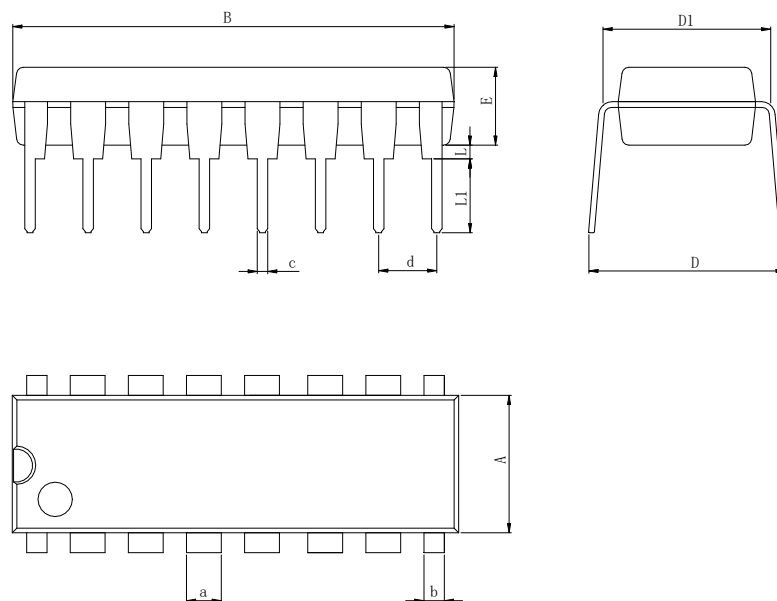
## Physical Dimensions

SOP-16



| Dimensions In Millimeters(SOP-16) |      |      |      |      |      |      |    |      |          |
|-----------------------------------|------|------|------|------|------|------|----|------|----------|
| Symbol:                           | A    | A1   | B    | C    | C1   | D    | Q  | a    | b        |
| Min:                              | 1.35 | 0.05 | 9.80 | 5.80 | 3.80 | 0.40 | 0° | 0.35 | 1.27 BSC |
| Max:                              | 1.55 | 0.20 | 10.0 | 6.20 | 4.00 | 0.80 | 8° | 0.45 |          |

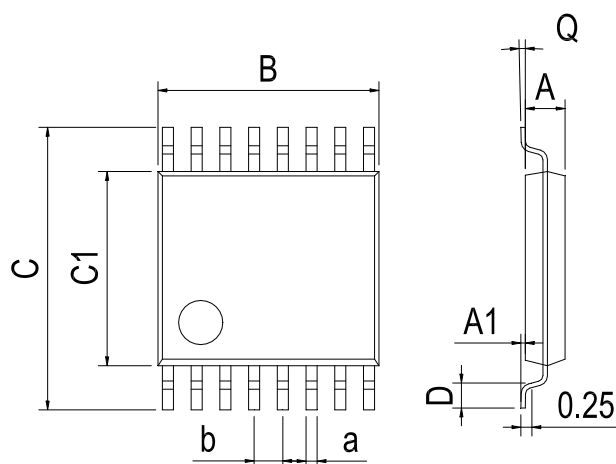
DIP-16



| Dimensions In Millimeters(DIP-16) |      |       |      |      |      |      |      |      |      |      |          |
|-----------------------------------|------|-------|------|------|------|------|------|------|------|------|----------|
| Symbol:                           | A    | B     | D    | D1   | E    | L    | L1   | a    | b    | c    | d        |
| Min:                              | 6.10 | 18.94 | 8.10 | 7.42 | 3.10 | 0.50 | 3.00 | 1.50 | 0.85 | 0.40 | 2.54 BSC |
| Max:                              | 6.68 | 19.56 | 10.9 | 7.82 | 3.55 | 0.70 | 3.60 | 1.55 | 0.90 | 0.50 |          |



TSSOP-16



| Dimensions In Millimeters(TSSOP-16) |      |      |      |      |      |      |    |      |          |
|-------------------------------------|------|------|------|------|------|------|----|------|----------|
| Symbol:                             | A    | A1   | B    | C    | C1   | D    | Q  | a    | b        |
| Min:                                | 0.85 | 0.05 | 4.90 | 6.20 | 4.30 | 0.40 | 0° | 0.20 | 0.65 BSC |
| Max:                                | 0.95 | 0.20 | 5.10 | 6.60 | 4.50 | 0.80 | 8° | 0.25 |          |

## Revision History

| REVISION<br>NUMBER | DATE    | REVISION                                                     | PAGE  |
|--------------------|---------|--------------------------------------------------------------|-------|
| V1.0               | 2018-8  | New                                                          | 1-11  |
| V1.1               | 2019-9  | Update encapsulation、 Add annotation for Maximum Ratings.    | 1、 3  |
| V1.2               | 2024-11 | Add a model marking name、 Update Lead Temperature            | 1、 3  |
| V1.3               | 2025-9  | Delete the power supply voltage range 2.0 to 6.0 V           | 1     |
| V1.4               | 2025-12 | Update important statements、 Update SOP-16 Dimension drawing | 8、 11 |

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