



钜地半导体
Tudi Semiconductor

Product Specification

TUDI-MAX3232E

Multi-channel RS-232 line driver and receiver with $\pm 15\text{kV}$ IEC ESD protection function from 3V to 5.0V

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**semiconductor device
manufacturer**

- Design
- research and development
- production
- and sales



Features

- ESD protection for RS-232 bus pins
 - $\pm 15\text{kV}$ (HBM)
 - $\pm 8\text{kV}$ (I61000-4-2, contact discharge)
 - $\pm 15\text{kV}$ (IEC61000-4-2, air gap discharge)
- Meets or exceeds requirements of TIA/EIA-232-F and ITU V.28 standards
- Powered by 3V to 5.5V VCC power supply
- Data rates up to 250kbit/s
- Two drivers and two receivers
- Low power current: 30 μA (typical)
- External capacitors: $4 \times 0.1\mu\text{F}$
- Accepts 5V logic input and 3.3V

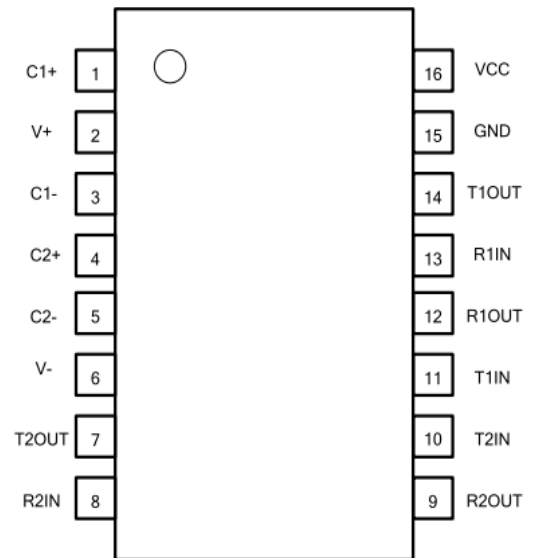


Figure 1. Pin Diagram

Description

The MAX3232E device consists of two line drivers, two line receivers, and a dual-path charge pump circuit with pin-topin (serial port connection pins, including GND) $\pm 15\text{kV}$ IEC ESD protection. The device meets the requirements of TIA/EIA-232F and provides an electrical interface between asynchronous communication controllers and serial port connectors. The charge pump and four small external capacitors support single-supply operation from 3V-5.5V. The device operates at data signal transmission rates up to 250kbit/s and the driver output slew rate is maximized at 30/ μs .

Applications

- Industrial PC
- Wired network
- Data center and enterprise-level networking
- Battery-powered system
- PDA
- Notebook computer? Portable computer
- Handheld computer
- Handheld device



Pin description

| PIN | SYMBOL | DESCRIPTION |
|-----|--------|--|
| 1 | C1+ | Positive Terminal for the first Charge Pump Capacitor |
| 2 | V+ | Doubled Voltage Terminal |
| 3 | C1- | Negative Terminal for the first Charge Pump Capacitor |
| 4 | C2+ | Positive Terminal for the second Charge Pump Capacitor |
| 5 | C2- | Negative Terminal for the second Charge Pump Capacitor |
| 6 | V- | Inverted Voltage Terminal |
| 7 | T2OUT | Second Transmitter Output Voltage |
| 8 | R2IN | Second Receiver Input Voltage |
| 9 | R2OUT | Second Receiver Output Voltage |
| 10 | T2IN | Second Transmitter Input Voltage |
| 11 | T1IN | First Transmitter Input Voltage |
| 12 | R1OUT | First Receiver Output Voltage |
| 13 | R1IN | First Receiver Input Voltage |
| 14 | T1OUT | First Transmitter Output Voltage |
| 15 | GND | Ground |
| 16 | VCC | Supply Voltage |



Parameter limit

| PARAMETER | SYMBOL | VALUE | UNIT |
|----------------------------------|-------------|--------------|------|
| Supply voltage | VCC | -0.3~+6 | V |
| Doubled Voltage Terminal | V+ | VCC-0.3~+7 | V |
| Inverted Voltage Terminal | V- | +0.3~-7 | V |
| $V_{++} V_{-I}$ | | +13 | V |
| Transmitter Input Voltage Range | T1IN,T2IN | -0.3~+6 | V |
| Receiver Input Voltage Range | R1IN,R2IN | ± 25 | V |
| Transmitter Output Voltage Range | T1OUT,T2OUT | ± 13.2 | V |
| Receiver Output Voltage Range | R1OUT,R2OUT | -0.3~VCC+0.3 | V |
| Operating Temperature | | -40~125 | °C |
| Storage Temperature | | -60~150 | °C |
| Soldering Temperature | | 300 | °C |
| Continuous Power | SOP16 | 760 | mW |
| | DIP16 | 840 | mW |

The maximum limit parameters means that exceeding these values may cause irreversible damage to the device. Under these conditions, it is not conducive to the normal operation of the device. The continuous operation of the device at the maximum allowable rating may affect the reliability of the device. The reference point for all voltages is ground.

Logic Input Electrical Characteristics

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------|---------|-----------|------|------|---------|---------|
| Logic Control Low Level | VTTIN_L | T1IN,T2IN | | | 0.8 | V |
| Logic Control High Level | VTTINH | T1IN,T2IN | 2 | | | V |
| Logic Control Hysteresis | | T1IN,T2IN | | 0.3 | | V |
| Input Logic Current | ITIN | T1IN,T2IN | | | ± 1 | μA |

(If there is no additional explanation,typical value is tested when VCC=+3.3V,Temp=25 ,C1-C4=1 μF)



Receiver Output Electrical Characteristics

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|------------------------------------|--------|---|---------|---------|------|------|
| Receiver Output Logic-Low Voltage | VROL | IO _{UT} =1.6mA, VCC=5V or 3.3V | | | 0.4 | V |
| Receiver Output Logic-High Voltage | VROH | IO _{UT} =-0.5mA, VCC=5V or 3.3V | VCC-0.6 | VCC-0.1 | | V |

(If there is no additional explanation,typical value is tested when VCC=+3.3V,Temp=25℃,C1-C4=1μF)

Receiver Input Electrical Characteristics

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|-------------------------------|--------|-----------|------|------|------|------|
| Receiver Input Range | VRIN | | -25 | | +25 | V |
| Receiver Input Low Threshold | VRL | VCC=3.3V | 0.6 | 1.1 | | V |
| | | VCC=5V | 0.8 | 1.5 | | V |
| Receiver Input High Threshold | VRIH | VCC=3.3V | | 1.5 | 2.4 | V |
| | | VCC=5V | | 1.9 | 2.4 | V |
| Receiver Input Hysteresis | | | | 0.4 | | V |
| Receiver Input Impedance | RRIN | | 3 | 5 | 7 | kΩ |

(If there is no additional explanation,typical value is tested when VCC=+3.3V,Temp=25℃,C1-C4=1μF)

Transmitter Output Electrical Characteristics

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------------------|--------|---|------|------|------|------|
| Transmitter Output Swing | VTOUT | All output ports of transmitter connect 3kΩload to ground | ±4 | | ±5 | V |
| Transmitter Output Impedance | RTOUT | VCC=0V, Transmitter Input=±2V | 300 | | | Ω |
| Transmitter Short-Circuit Current | Itsc | | | | 60 | mA |

(If there is no additional explanation,typical value is tested when VCC=+3.3V,Temp=25℃,C1-C4=1μF)



Supply Current

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|-----------------------------|------------------|-----------|------|------|------|------|
| Supply Current with no Load | I _{sup} | | | 2 | | mA |

(If there is no additional explanation,typical value is tested when VCC=+3.3V,Temp=25 ,C1-C4=1 μ F)

ESD Protection

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------|--------|-------------------|------|------|------|------|
| R1IN、R2IN T1OUT、T2OUT | | HBM | | ±15 | | KV |
| | | Air Discharge | | ±15 | | KV |
| | | Contact Discharge | | ±8 | | KV |

Switching Characteristics Parameter

| PARAMETER | SYMBOL | CONDITION | MIN. | TYP. | MAX. | UNIT |
|----------------------------|--------|--|------|------|------|------|
| Rate | Speed | RL=3kΩ, CL=1000pF | | 120 | | kbps |
| Receiver Propagation delay | tRPHL | CL=150pF | | 300 | | ns |
| | tRPLH | | | 300 | | ns |
| tRPHL-tRPLH | | | | 150 | | ns |
| tTPHL-tTPLH | | | | 150 | | ns |
| Transmitter Slew Rate | SR | RL=3kΩ~7kΩ, CL=150pF~1000pF from-3.0V~3.0V or from3.0V~-3.0V See figures 2 and 3 | 4 | | 30 | V/μs |

(If there is no additional explanation,typical value is tested when VCC=+3.3V,Temp=25 ,C1-C4=1 μ F)



TEST CIRCUIT

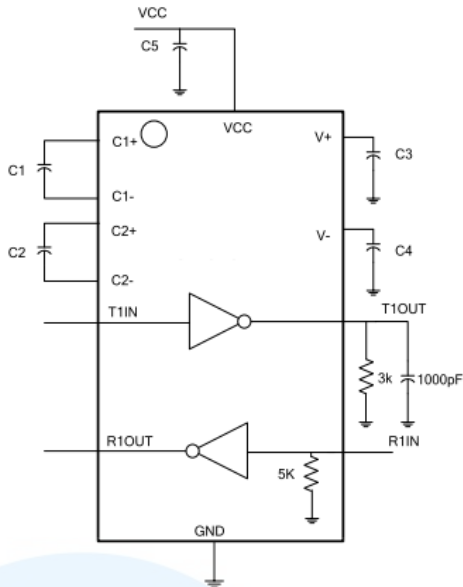


Figure 2 minimum swing rate test circuit

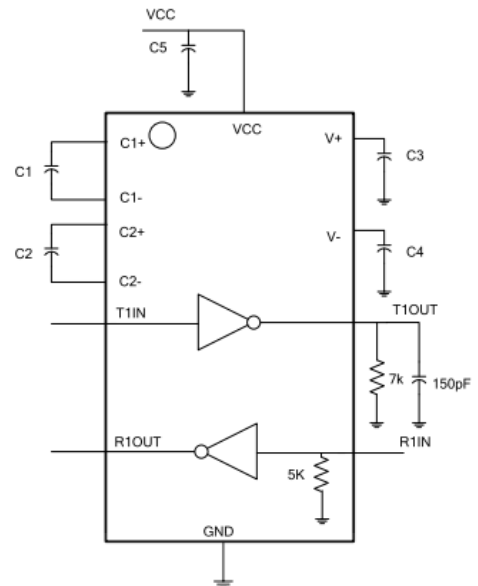


Figure 3 maximum swing rate test circuit

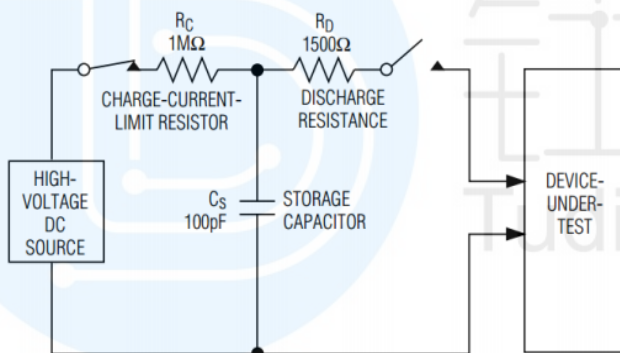


Figure 4 ESD test model of human body mode

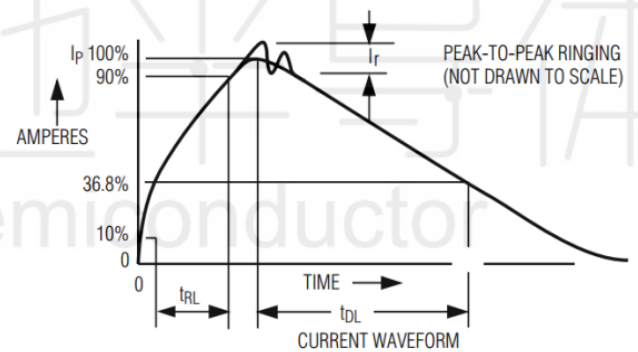


Figure 5 human body mode current waveform

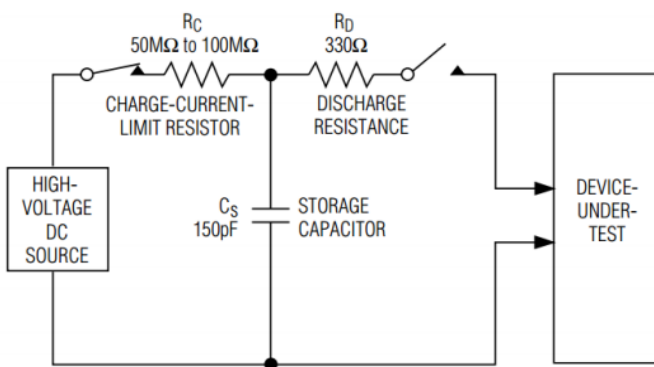


Figure 6 ESD test model of IEC 1000-4-2

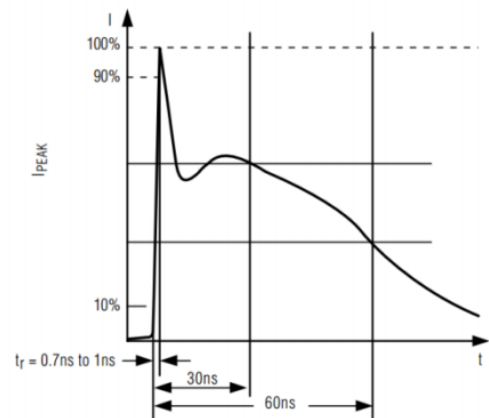


Figure 7 current waveform of IEC 1000-4-2 ESD



Description

| RS232 Receiver |
|--|
| The 3232 has two separate receivers that convert the RS-232 signal to the CMOS logic output level. |
| ESD Protection |
| All pins of 3232 adopt ESD protection structure, and all driver outputs and receiver inputs have additional electrostatic protection capability. It can withstand $\pm 15\text{kV}$ ESD (HBM) discharge, contact discharge above $\pm 8\text{kV}$ and air gap discharge above $\pm 15\text{kV}$. The ESD protection structure can withstand the impact of high voltage ESD under all conditions, including standard working mode and power-off mode. |
| Typical Application |
| Typical dual-Path application scenarios are shown in Figure 8, where the C1-C5 typical capacitance value is $0.1\mu\text{F}$. |
| Dual Charge-Pump Operation |
| 3232 has a two-way charge pump inside to support the chip's voltage conversion work. Dual-electric pump provides $+5.5\text{V}$ and -5.5V output voltage in the range of $3.0\text{--}5.5\text{V}$. Each charge pump requires a capacitor (C1, C2) and an energy storage capacitor (C3, C4) to generate $V+$ and $V-$ power supplies, as shown in Fig 8. |
| RS232 Transmitter |
| Convert the TTL/CMOS logic voltage to a voltage compatible with the EIA/TIA-232 standard. 3232 Transmitter can guarantee 250kbps data rate under the worst operating conditions (Parallel load of $3\text{k}\Omega$ resistor and 1000pF capacitor). Transmitter can drive multiple receivers in parallel. There is no pull-up resistance inside the input terminals T1IN and T2IN of 3232 transmitter. If the transmitter is not used, the unused input terminals T1IN and T2IN can be connected to GND or VCC. |

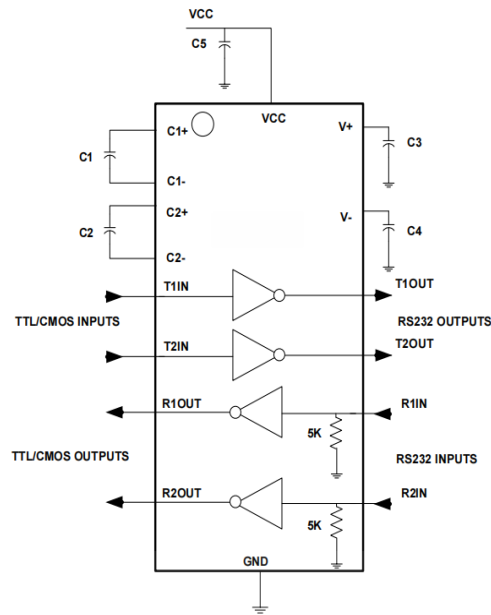


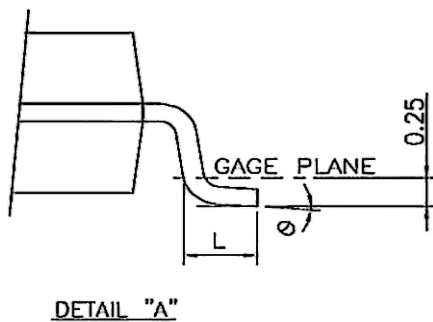
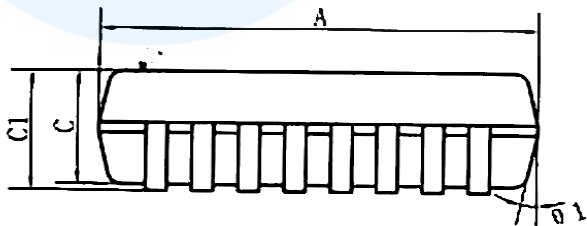
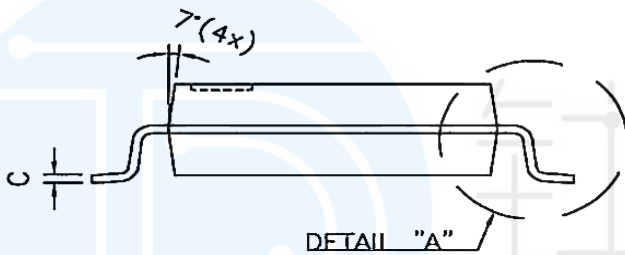
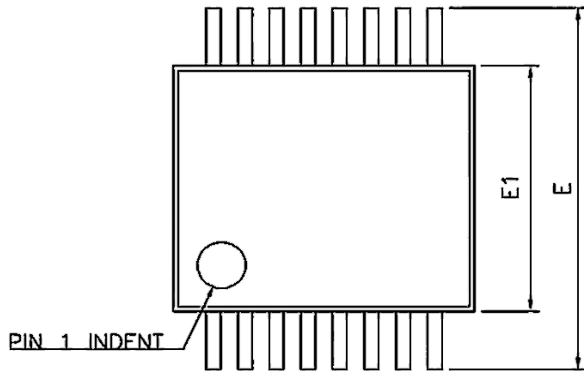
Figure 8 Typical dual-Path application scenarios

Order information

| Order Number | Package | Package Quantity | Marking On The park | Temperature |
|---------------------|---------|------------------|------------------------|-----------------|
| MAX3232ECDBR-TUDI | SSOP16 | Tape,Reel,2000 | MP232EC | 0°C to 70°C |
| MAX3232ECDR-TUDI | SOP16 | Tape,Reel,2500 | MAX3232EC | |
| MAX3232ECDWR-TUDI | SMD16 | Tape,Reel,1000 | MAX3232EC | |
| MAX3232ECPWR-TUDI | TSSOP16 | Tape,Reel,2000 | MP232EC | |
| MAX3232EIDBR-TUDI | SSOP16 | Tape,Reel,2000 | MP232EI | - 40°C to 85°C |
| MAX3232EIDR-TUDI | SOP16 | Tape,Reel,2500 | MAX3232EI | |
| MAX3232EIDWR-TUDI | SMD16 | Tape,Reel,1000 | MAX3232EI | |
| MAX3232EIPWR-TUDI | TSSOP16 | Tape,Reel,2000 | MP232EI | |
| MAX3232EIPWRQ1-TUDI | TSSOP16 | Tape,Reel,2000 | MB3232I | - 40°C to 125°C |

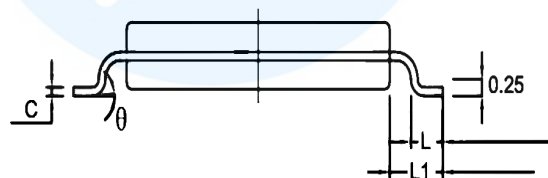
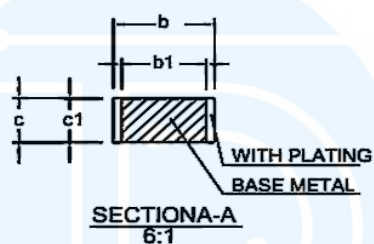
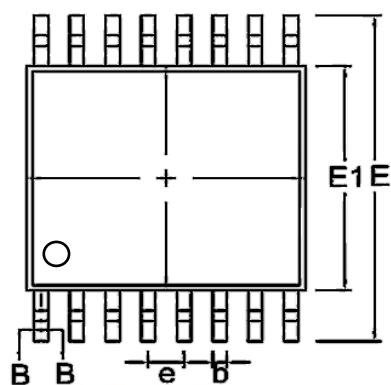


Package SSOP16

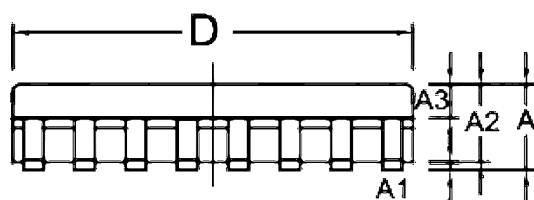


| SIZE SYMBOL | MIN/mm | MAX/mm |
|----------------|----------|--------|
| A | 6.15 | 6.25 |
| A1 | 0.30TYP | |
| A2 | 0.65TYP | |
| A3 | 0.675TYP | |
| B | 5.25 | 5.35 |
| B1 | 7.65 | 7.95 |
| B2 | 0.60 | 0.80 |
| C | 1.70 | 1.80 |
| C1 | 1.75 | 1.95 |
| C2 | 0.799 | |
| C3 | 0.152 | |
| C4 | 0.172 | |
| H | 0.05 | 0.15 |
| θ | 12°TYP4 | |
| 01 | 12°TYP4 | |
| 02 | 10°TYP | |
| 03 | 0°~8° | |
| R | 0.20°TYP | |
| R | 0.15°TYP | |

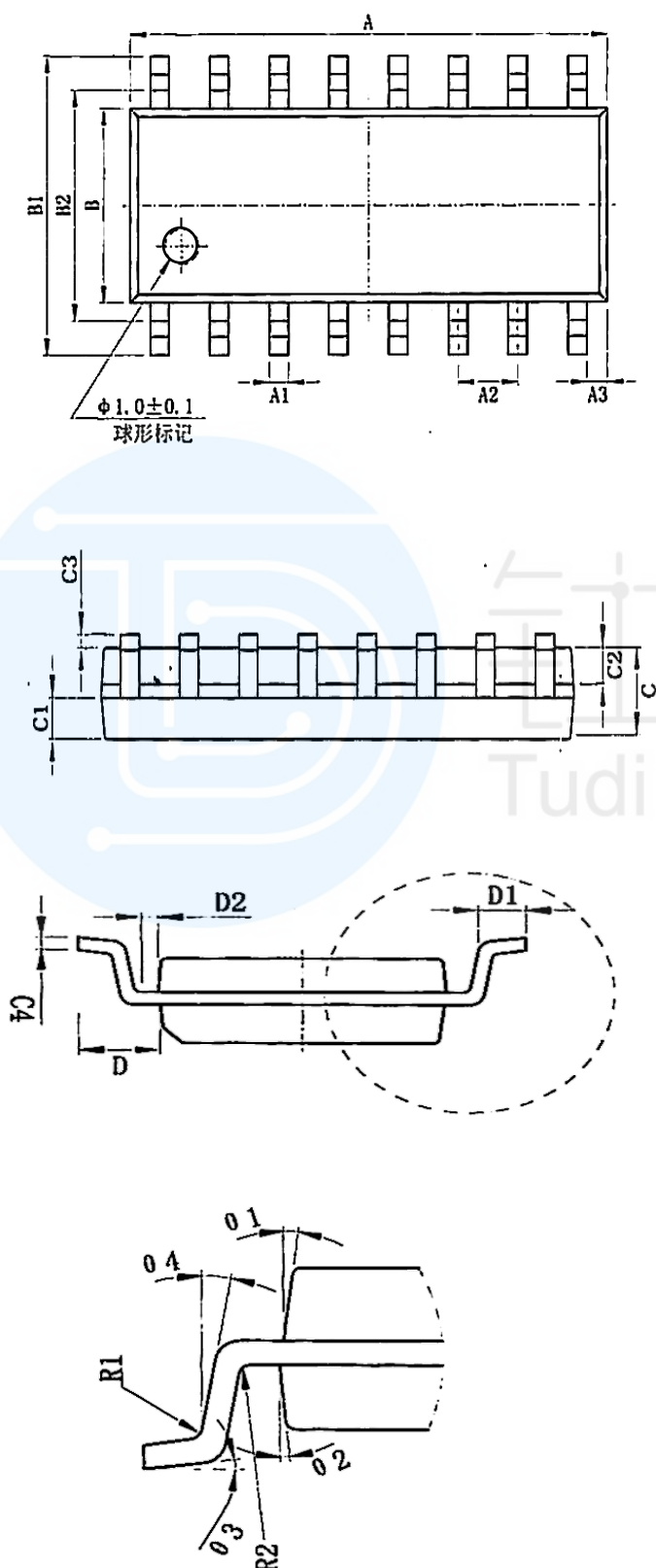
Package TSSOP16



| SIZE SYMBOL | MIN./mm | TYP./mm | MAX./mm |
|----------------|---------|---------|---------|
| A | -- | -- | 1.20 |
| A1 | 0.05 | | 0.15 |
| A2 | 0.90 | 1.00 | 1.05 |
| b | 0.20 | -- | 0.30 |
| b1 | 0.19 | 0.22 | 0.25 |
| C | 0.110 | 0.127 | 0.145 |
| cl | 0.12 | 0.13 | 0.14 |
| D | 4.86 | 4.96 | 5.06 |
| E | 6.20 | 6.40 | 6.60 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | 0.65BSC | | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | 1.00BSC | | |
| | 0° | -- | 8° |



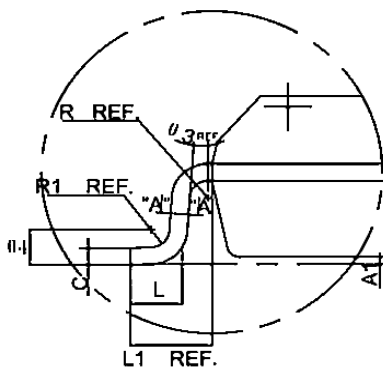
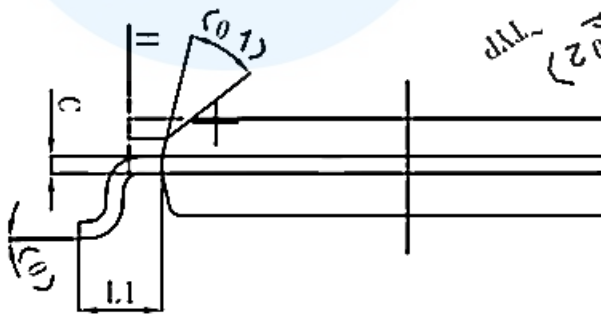
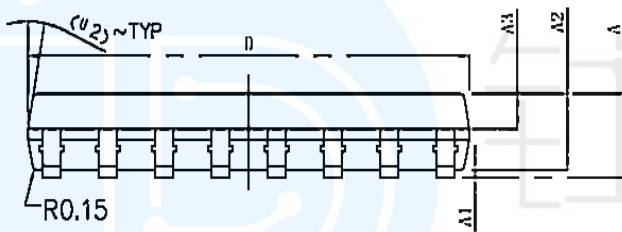
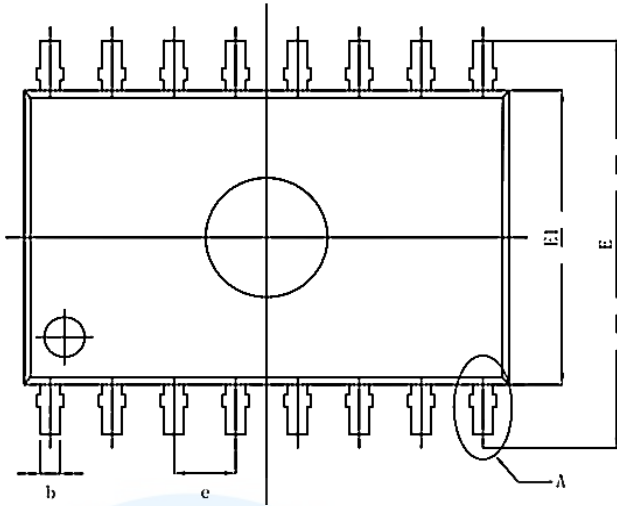
Package SOP16



| SIZE SYMBOL | MIN./mm | MAX./mm |
|----------------|------------|---------|
| A | 9.80 | 10.00 |
| A1 | 0.356 | 0.456 |
| A2 | 1.27TYP | |
| A3 | 0.302TYP | |
| B | 3.85 | 3.95 |
| B1 | 5.84 | 6.24 |
| B2 | 5.00 TYP | |
| C | 1.40 | 1.60 |
| C1 | 0.61 | 0.71 |
| C2 | 0.54 | 0.64 |
| C3 | 0.05 | 0.25 |
| C4 | 0.203 | 0.233 |
| D | 1.05 TYP | |
| D1 | 0.40 | 0.70 |
| D2 | 0.15 | 0.25 |
| R1 | 0.20TYP | |
| R2 | 0.20TYP | |
| 01 | 8°~12°TYP4 | |
| 02 | 8°~12°TYP4 | |
| 03 | 0°~8° | |
| 04 | 4°~12° | |



Package SMD16



| SIZE SYMBOL | MIN./mm | MAX./mm |
|----------------|---------|---------|
| A | — | 2.65 |
| A1 | 0.10 | 0.30 |
| A2 | 2.25 | 2.35 |
| A3 | 0.97 | 1.07 |
| D | 10.10 | 10.50 |
| E | 10.26 | 10.60 |
| E1 | 7.30 | 7.70 |
| e | 1.27BSC | |
| L | 0.55 | 0.85 |
| L1 | 1.4BSC | |
| H | 0.345 | 0.365 |
| R | 0.20TYP | |
| R1 | 0.30TYP | |
| θ | 0° | 8° |
| θ 1 | 45° TYP | |
| 02 | 12° TYP | |
| 03 | 0° | 8° |
| 04 | 0° | 10° |



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