



钜地半导体
Tudi Semiconductor

Product Specification

TUDI-ZT232E/ZT232LE

Low Power 5V 250Kbps RS232 Transceivers Datasheet

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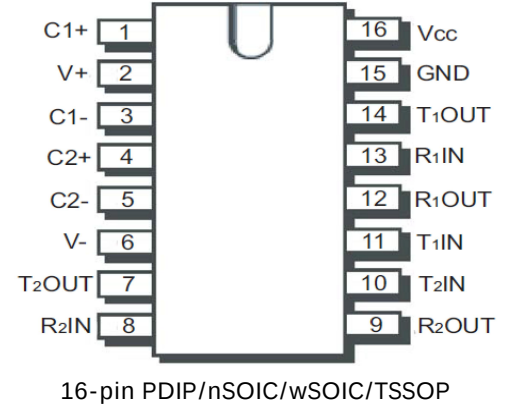
**semiconductor device
manufacturer**

- Design
- research and development
- production
- and sales



Features

- Meets EIA/TIA-232F and CCITT V.28/V.24 specifications for V_{CC} at $+5V \pm 10\%$
- Low Quiescent Current – 3mA typ., 5mA max.
- Guaranteed Standard Data Rate 250Kbps
- Proprietary Switch-Capacitor Regulated Voltage Converters (patent pending)
- Use Small 0.1 μ F Capacitors
- Latch-up Free
- ESD Protection for RS-232 I/O's $\pm 15KV$ Human Body Model (HBM)
- Drop-in Replacements for MAX202E, MAX232E, SP202E, SP232E, ST202E, ST232E, HIN202E, HIN232E, ADM202E, ADM232L
- High Data Rate at 1000Kbps Available on ZT232F Series



Applications

- Single Power Supply Applications
- Industrial and Embedded PCs
- Set Top Boxes
- Terminal Adapters
- POS terminals
- Peripherals Interface
- Routers and HUBs

General Description

The ZT232E series devices are +5V powered EIA/TIA-232 and CCITT V.28/V.24 communication interfaces with low power requirements. These transceivers consist of two line drivers, two line receivers and the proprietary switch-capacitor regulated voltage converters. These devices operate from a single +5V power supply at the guaranteed data rate of 250K bits/sec with enhanced electrostatic discharge (ESD) protection in all RS232 I/O pins exceeding $\pm 15KV$ HBM.



Absolute Maximum Ratings

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

Power Supply, (V_{CC}).....	-0.3V to +6.0V
$V+$	-0.3V to +7.0V
$V-$	+0.3V to -7.0V
$ V+ + V- $	+13.0V
I_{CC} (DC V_{CC} or GND current).....	$\pm 100\text{mA}$

Input Voltages

$TxIN$	-0.3V to +6.0V
$RxIN$	$\pm 25\text{V}$

Output Voltages

$TxOUT$	$\pm 12\text{V}$
$RxOUT$	-0.3V to ($V_{CC} + 0.3\text{V}$)

Short-Circuit Duration

$TxOUT$	Continuous
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Operating Temperature..... -40°C to +85°C

Storage Temperature..... -65°C to +150°C

Power Dissipation Per Package

16-pin PDIP (derate 11.20mW/°C above +70°C)	896mW
16-pin nSOIC (derate 10.00mW/°C above +70°C)	720mW
16-pin wSOIC (derate 10.10mW/°C above +70°C)	787mW
16-pin TSSOP (derate 6.80mW/°C above +70°C)	556mW

Storage Considerations

Storage in a low humidity environment is preferred. Large high density plastic packages are moisture sensitive and should be stored in Dry Vapor Barrier Bags. Prior to usage, the parts should remain bagged and stored below 40°C and 60%RH. If the parts are removed from the bag, they should be used within 168 hours or stored in an environment at or below 20%RH. If the above conditions cannot be followed, the parts should be baked for 12 hours at 125°C in order to remove moisture prior to soldering. ASIX ships product in Dry Vapor Barrier Bags with a humidity indicator card and desiccant pack. The humidity indicator should be below 30%RH. The MSL of this product is 3.

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1 Electrical Characteristics

Unless otherwise stated, $V_{CC} = +5.0V$, $T_A = T_{min}$ to T_{max} , $C1$ to $C4 = 0.1\mu F$, typical values apply at $V_{CC} = +5.0V$ and $T_A = 25^\circ C$.

Parameter	Condition	Min	Typ	Max	Units
TTL Logic Input TTL Logic Output RS-232 Input RS-232 Output Charge Pump Pin Power Pin	T1IN, T2IN R1OUT, R2OUT R1IN, R2IN T1OUT, T2OUT C1P, C1N, C2P, C2N V_{CC} , V_{GND} , V_{DD} , V_{SS}	See specifications below			
Charge Pump Caps	C1P, C1N, C2P, C2N	0.1	0.1	1.0	μF
Temp $0^\circ C$ to $+70^\circ C$	Commercial Grade	0	+25	+70	$^\circ C$
Temp $-40^\circ C$ to $+85^\circ C$	Industrial Grade	-40	+25	+85	$^\circ C$
V_{CC} Voltage Range	$V_{CC} = +5.0V$ Supply	4.5	5	5.5	V
Supply Current Quiescent	TTL Inputs = V_{CC}/GND , RS-232 Input = float, $T_A = 25^\circ C$ $V_{CC} = +5.0V \pm 10\%$, No load on transmitter outputs (for ZT232E) (for ZT202E)		3 4	5 8	mA mA
Supply Current Transmitters Loaded	TTL Inputs = V_{CC}/GND , RS-232 Inputs = float, $T_A = 25^\circ C$ $V_{CC} = +5.0V$, All transmitter outputs loaded with $R_L = 3K\Omega$		15		mA
TTL LOGIC Input Input Threshold Low Input Threshold High Input Hysteresis Input Leakage Current	$V_{CC} = +5.0V$ Supply T1IN, T2IN T1IN, T2IN T1IN, T2IN $T_{XIN} = GND$	2.4	0.5 15	0.8 200	V V V μA
TTL LOGIC Output Output Voltage Low Output Voltage High	$I_{OUT} = 3.2mA$ $I_{OUT} = -1.0mA$	3.5		0.4	V V
Receiver Input Input Voltage Range Input Threshold Low Input Threshold High Input Hysteresis Input Resistance	$T_A = T_{min} - T_{max}$ $T_A = 25^\circ C$, $V_{CC} = 5.0V$ $V_{CC} = +5.0V$ Supply $T_A = 25^\circ C$ $V_{IN} = \pm 25V$, $T_A = 25^\circ C$	-25 0.8 0.2 3	1.2 1.7 0.5	25 2.4 1.0 7	V V V K Ω
Transmitter Output Output Voltage Swing Output Resistance Output Short-Circuit Current	$R_L = 3\sim 7K\Omega$, All Outputs are loaded (for ZT232E) $R_L = 3\sim 7K\Omega$, All Outputs are loaded, $V_{CC} = 5.25V$ (for ZT202E) $V_{CC} = V_{DD} = V_{SS} = GND$, $V_{OUT} = \pm 2V$ $V_{OUT} = GND$	± 5 ± 5 300	± 6 ± 9 ± 20		V V Ω mA



Parameter	Condition	Min	Typ	Max	Units
Timing Characteristics					
Maximum Data Rate One Transmitter (1Tx/1Rx) Switching	$R_L = 3\sim 7K\Omega$, $C_L = 50\sim 2500pF$, $T_A = 25^\circ C$	250			Kbps
Transition-Region Slew Rate	$R_L = 3\sim 7K\Omega$, $C_L = 50p\sim 2500pF$, One Transmitter Switching, $T_A = 25^\circ C$, Measured from +3V to -3V or -3V to +3V, $V_{CC} = 4.5V$	6		30	V/ μs
Transmitter Propagation t_{PLH} Transmitter Propagation t_{PHL} Transmitter Skew	All transmitters loaded with $R_L = 3K\Omega$, $C_L = 1000pF$ All transmitters loaded with $R_L = 3K\Omega$, $C_L = 1000pF$ $t_{PHL} - t_{PLH}$		2.0 2.0 100		μs μs ns
Receiver Propagation t_{PLH} Receiver Propagation t_{PHL} Receiver Skew	$C_L = 150pF$ $C_L = 150pF$ $t_{PHL} - t_{PLH}$		0.15 0.15 50		μs μs ns
ESD Tolerance					
RS-232 I/Os ESD HBM			± 15		KV
TTL/CMOS I/Os ESD HBM			± 2		KV



2 Circuit Description

Proprietary Switch-Capacitor Regulated Voltage Converter

Different from other suppliers, ASIX uses a patent pending switch-capacitor voltage-controlled source and sink current generators design to provide powerful bipolar voltages to maintain compliant EIA/RS232 levels regardless of power supply fluctuations. The design consists of an internal regulated oscillator, a two phase clock cycling, regulated complementary MOS switches, fast switching diode and switch capacitors.

The switch capacitor bi-directional current generators operate with ASIX's proprietary smartly regulated complementary MOS switches and fast switching diode from its proprietary high voltage process technology. The efficiency of these bidirectional current generators is well over 70%. The switching frequency is generated by an internal oscillator and regulated by the current loads. The switch capacitor pump design delivers higher negative bucked voltage than the positive boosted voltage to achieve a balanced voltage controlled source and sink current generators resulting a balanced bipolar voltage supplies to the chip.

With its unique proprietary design technique, ASIX's interface product series provide a better power efficient, stable and compliant EIA/RS232 levels with superior low power consumption.

ESD Immunity

Electro-Static Discharge (ESD) is an important factor when implementing a serial port into a system. In some applications, it is crucial that the ESD protection for the system must meet a certain tolerance level. Since RS232 transceiver devices are exposed to the outside world, there are many environmental factors that can affect the serial port and even subject it to transients that could potentially damage the transceiver itself.

The RS232 transceiver is usually routed from the serial port connector to the transceiver IC through the metal trace on the printed circuit board. This trace will have some small amount of resistance that will add some protection in terms of limiting transient current to the IC. However for added voltage protection, transient voltage suppressors (TVS) or transzorbs, which are back-to-back diode arrays clamp, are usually necessary to protect the serial port circuitry.

To further reduce cost within their system, more engineers are requiring higher ESD tolerances from the transceiver ICs themselves without having to add costly TVS circuitry. ASIX's RS232 transceivers include built-in transient voltage suppression where external ESD circuitry is not necessary to meet the MIL-STD-883, Method 3015, Human Body Model and the EN61000-4-2 Air/Contact Discharge tests.

The Human Body Model has been the generally accepted ESD testing method for semiconductors. This test is intended to simulate the human body's potential to store electrostatic energy and discharge it to an integrated circuit upon close proximity or contact. This method will test the IC's capability to withstand an ESD transient during normal handling such as in manufacturing areas where the ICs tend to be handled frequently.

EN61000-4-2 is used for testing ESD on equipment and systems. For system manufacturers, they must guarantee a certain amount of ESD protection since the system itself is exposed to the outside environment and human presence. EN61000-4-2 specifies that the system is required to withstand an amount of static electricity when ESD is applied to exposed metal points and surfaces of the equipment that are accessible to personnel during normal usage. The transceiver IC receives most of the ESD current when the ESD source is applied to the connector pins.



There are two methods within EN61000-4-2, the Air Discharge method and the Contact Discharge method. With the Air Discharge Method, an ESD voltage is applied to the equipment under test through air, which simulates an electrically charged person ready to connect a cable onto the rear of the system and the high energy potential on the person discharges through an arcing path to the rear panel of the system before he or she even touches the system. The Contact Discharge Method applies the ESD current directly to the EUT. This method was devised to reduce the unpredictability of the ESD arc. The discharge current rise time is constant since the energy is directly transferred without the air-gap arc inconsistencies.

Specification	RS-232D	RS-423A	RS-422	RS-485	RS-562
Mode of Operation	Single-Ended	Single-Ended	Differential	Differential	Single-Ended
No. of Drivers and Receivers Allowed on One Line	1 Driver 1 Receiver	1 Driver 10 Receivers	1 Driver 10 Receivers	32 Drivers 32 Receivers	1 Driver 1 Receiver
Maximum Cable Length	50 feet	4,000 feet	4,000 feet	4,000 feet	$C \leq 2,500 \text{ pF@ } <20\text{Kbps}$; $C \leq 1,000 \text{ pF@ } >20\text{Kbps}$
Maximum Data Rate	20 Kbps	100 Kbps	10 Mbps	10 Mbps	64 Kbps
Driver Output Maximum Voltage	$\pm 25\text{V}$	$\pm 6\text{V}$	-0.25V to +6V	-7V to +12V	-3.7V to +13.2V
Driver Output Signal Level Loaded	$\pm 5\text{V}$	$\pm 3.6\text{V}$	$\pm 2\text{V}$	$\pm 1.5\text{V}$	$\pm 3.7\text{V}$
Unloaded	$\pm 15\text{V}$	$\pm 6\text{V}$	$\pm 5\text{V}$	$\pm 5\text{V}$	$\pm 13.2\text{V}$
Driver Load Impedance	3~7K Ω	450 Ω	100 Ω	54 Ω	3~7K Ω
Maximum Driver Output Current (High Impedance State)					
Power On				$\pm 100\mu\text{A}$	
Power Off	$V_{\text{MAX}}/300$	100 μA	$\pm 100\mu\text{A}$	$\pm 100\mu\text{A}$	
Slew Rate	30V/ μs max.	Controls Provided			30V/ μs max.
Receiver Input Voltage Range	$\pm 15\text{V}$	$\pm 12\text{V}$	-7V to +7V	-7V to +12V	$\pm 15\text{V}$
Receiver Input Sensitivity	$\pm 3\text{V}$	$\pm 200\text{mV}$	$\pm 200\text{mV}$	$\pm 200\text{mV}$	$\pm 3\text{V}$
Receiver Input Resistivity	3~7K Ω	4K Ω min.	4K Ω min.	12K Ω min.	3~7K Ω

Table 2. EIA Standard Parameter Summary

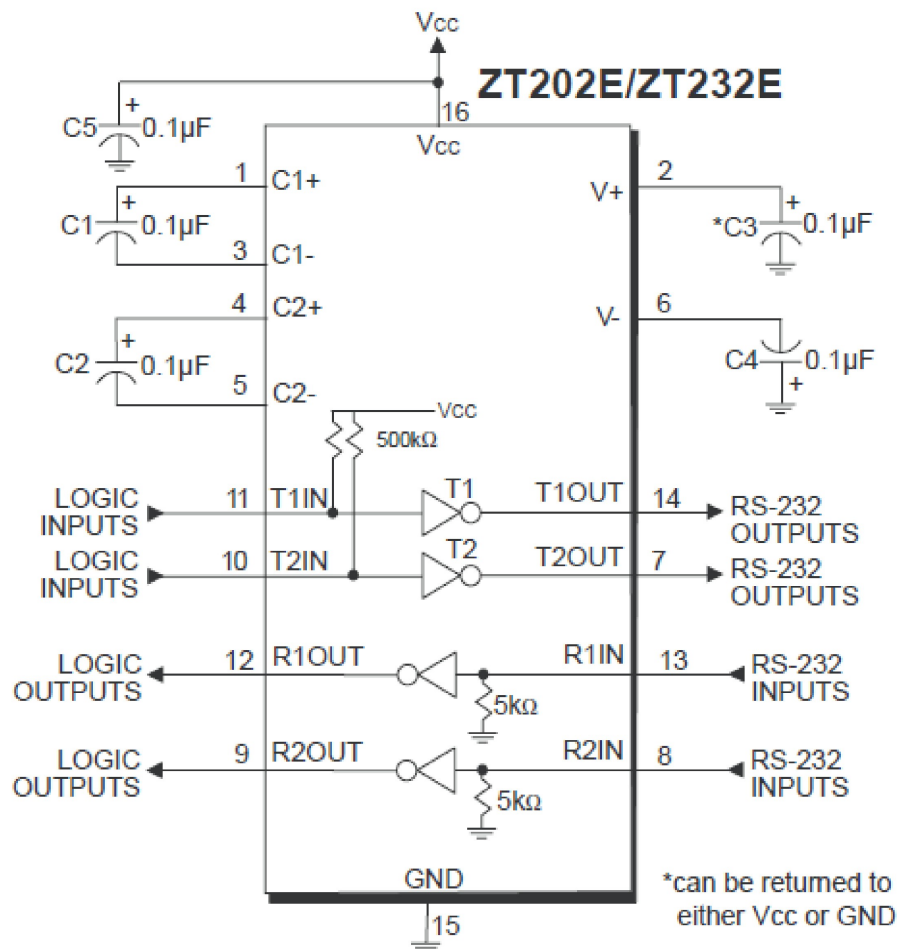


Test Circuit RS232 Signal Characteristics

Figure 1 shows the normal RS232 transceiver function with a TTL/CMOS signal applied to the input on channel 1 and the resultant RS232 output shown on channel 2. This figure shows a typical RS232 line driver output without loading. In other words, this is the open circuit RS232 output voltage. The charge pump voltage converter efficiently converts the necessary voltage for the driver's output transistors so that the RS232 output is close to the ideal rail voltage of 6.6V.

Figure 2 shows the RS232 transceiver function using the TTL/CMOS input on channel 1 while showing the RS232 output on channel 2. This figure shows the RS232 signal while the output is loaded with 3K ohms and 1000pF. The resistive load is the receiver's input impedance as the driver's output is looped back to the receiver's input. The resultant output on channel 3 is the receiver's TTL/CMOS output. While loaded with a typical RS232 load, the driver's output level only drops 0.2V from its open circuit voltage while running that 250Kbps. The RS-232 output on channel 2 also shows good signal integrity while at the high data rates, which allows the receiver to process the signal with minimum skew and delay. ASIX's low-drop driver circuitry working with its efficient voltage regulator allows superior line driving capability with the bonus of $\pm 15\text{KV}$ ESD immunity.

4 Typical Application Circuits

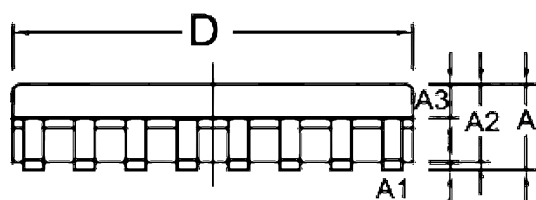
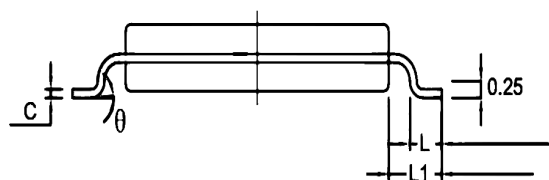
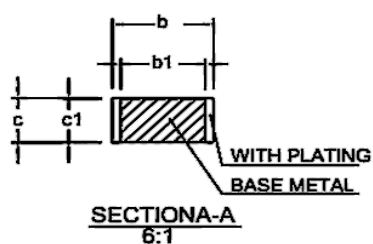
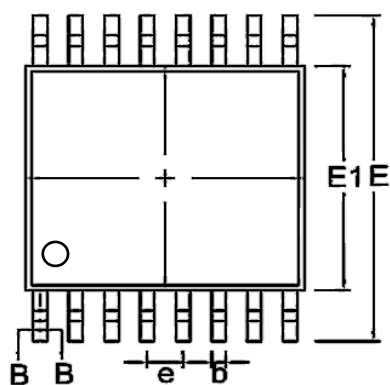




Order information

Order Number	Package	Package Quantity	Marking On The park
ZT232ECP-TUDI	DIP16	Tube,25,A box of 1000	ZT232ECP
ZT232ECT-TUDI	SMD16	Tape,Reel,1000	ZT232ECT
ZT232ECY-TUDI	TSSOP16	Tape,Reel,2500	ZT232ECY
ZT232EEP-TUDI	DIP16	Tube,25,A box of 1000	ZT232EEP
ZT232EEY-TUDI	SOP16	Tape,Reel,2500	ZT232EEY
ZT232LEEN-TUDI	SOP16	Tape,Reel,2500	ZT232LEEN
ZT232LEEP-TUDI	DIP16	Tube,25,A box of 1000	ZT232LEEP
ZT232LEET-TUDI	SMD16	Tape,Reel,1000	ZT232LEET
ZT232LEEY-TUDI	TSSOP16	Tape,Reel,2500	ZT232LEEY

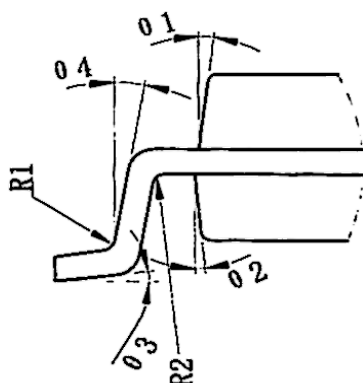
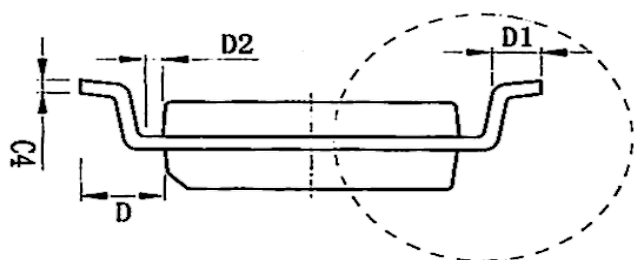
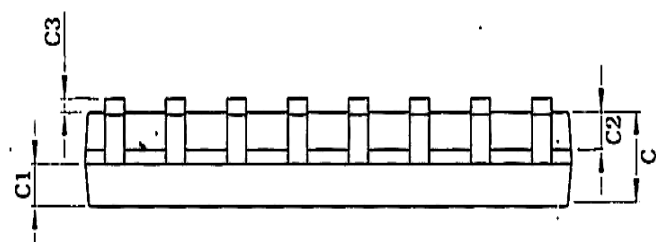
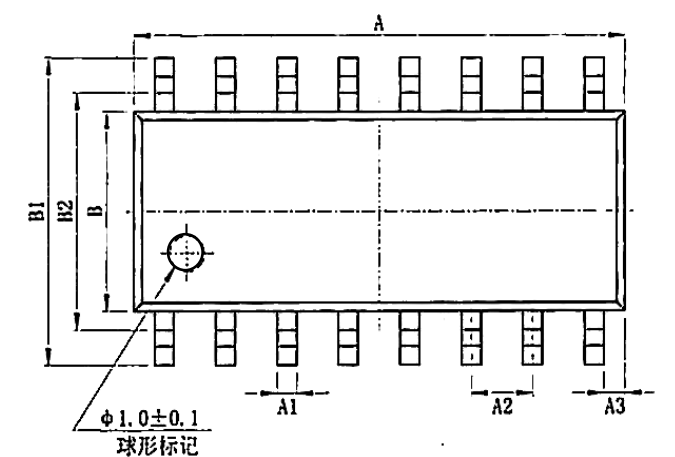
Package TSSOP16



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°

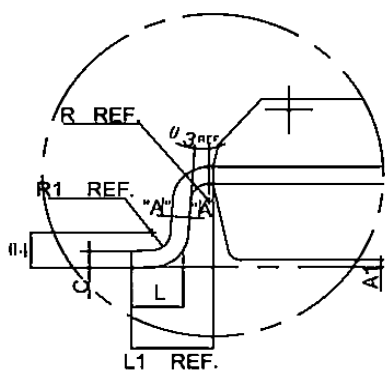
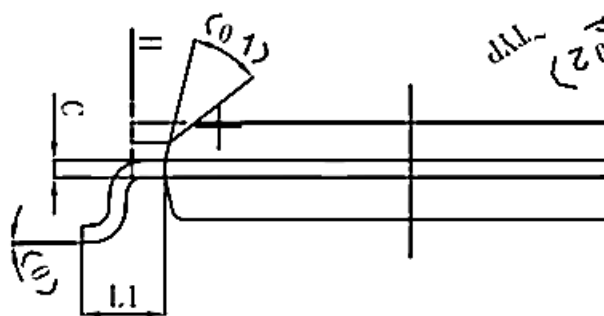
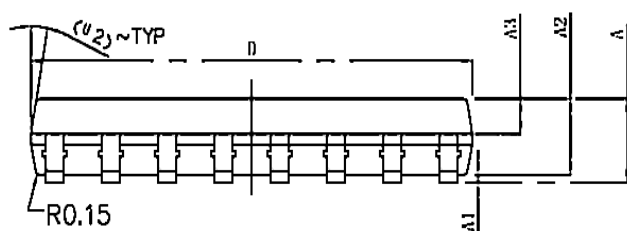
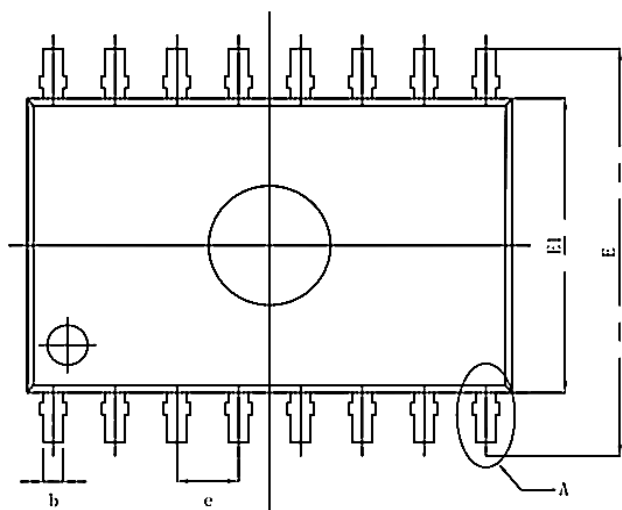


Package SOP16



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	
O1	8°~12°TYP4	
O2	8°~12°TYP4	
O3	0°~8°	
O4	4°~12°	

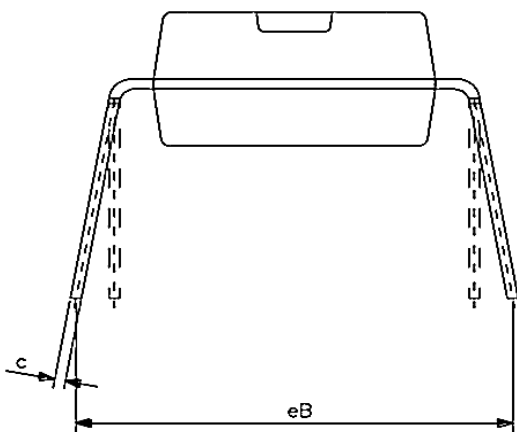
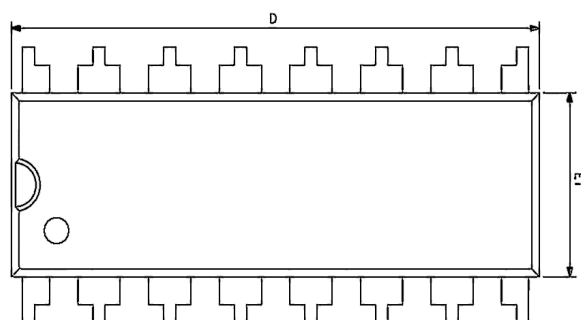
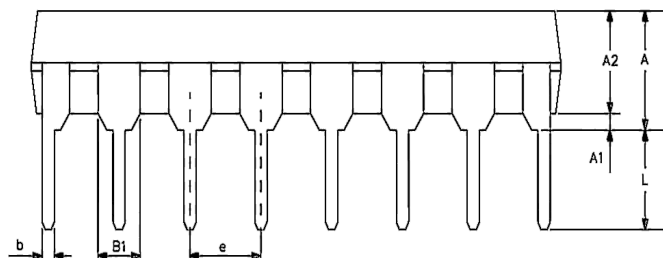
Package SMD16



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	
θ_2	12° TYP	
θ_3	0°	8°
θ_4	0°	10°



Package DIP16



SIZE SYMBOL	MIN./mm	MAX./mm
A2	3.20	3.60
A1	0.51	—
A	3.60	5.33
L	3.00	3.60
b	0.36	0.56
B1	1.52	
D	18.80	19.94
E1	6.20	6.60
e	2.54	
C	0.20	0.36
eB	7.62	9.30
R	0.20TYP	
R1	0.30TYP	
θ	0°	8°
$\theta 1$	45°TYP	
02	12°TYP	
03	0°	8°
04	0°	10°



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