钍地半导体
Tudi Semiconductor

Product Specification

TUDI-ZT3232E/ZT3232LE

Low Power 3V to 5.5V 250Kbps RS232 Transceivers Datasheet

网址 www.sztdbdt.com

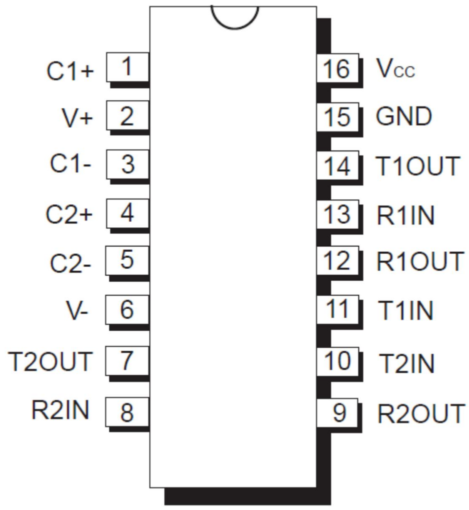
用芯智造·卓越品质

semiconductor device manufacturer

- Design
- research and development
- production
- and sales

Features

á Meets EIA/TIA-232F and CCITT V.28/V.24 specifications for VCC at +3.3V ±10% and +5V ±10%
á Low Quiescent Current: 0.5mA typ., 1mA max.
á Low Shutdown Current (where applicable): 1μA typical, 10μA max.
á Guaranteed Data Rate 250Kbps
á Proprietary Switch-Capacitor Regulated Voltage Converters (patent pending)
á Proprietary AUTOGREEN Power Saving (patent pending)
á Latch-up Free
á ESD Protection for RS-232 I/O's
±15KV Human Body Model (HBM)
±15KV EN61000-4-2 Air Gap Discharge
±8KV EN61000-4-2 Contact Discharge
á Drop-in Replacements for MAX3220E, SP3220E, MAX3221E, ICL3221E, MAX3222E, ICL3222E, SP3222E, MAX3223E, ICL3223E, SP3223E, MAX3232E, ICL3232E, SP3232E, LT1385, SP385E, IS3232E
á High Data Rate at 1000Kbps Available on ZT32xxF Series



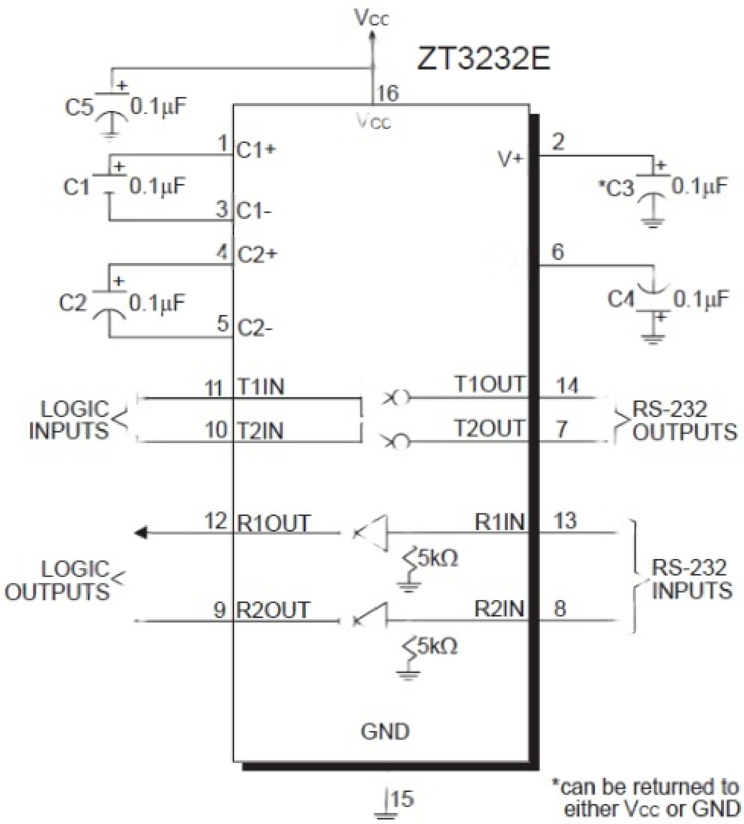
16-pin SSOP/TSSOP/NSOIC/WSOIC

Applications

á Battery-Powered And Hand-Held Applications
á Notebooks, Subnotebooks, and Palmtops
á Industrial and Embedded PCs
á Data Cables for Cell Phones and PDAs
á Terminal Adapters and POS terminals
á Peripherals interface
á Routers and HUBs

General Description

The ZT32xxE series devices are 3V powered EIA/TIA-232 and V.28/V.24 communication interfaces with low power requirements. They consist of two line drivers, two line receivers and the proprietary switch-capacitor regulated voltage converters. The ZT3220E has a 1Tx and 1Rx configuration. These devices operate from a single 3V to 5.5V power supply at the guaranteed data rate of 250K bits/sec with enhanced electrostatic discharge (ESD) protection in all RS232 I/O pins exceeding ±15KV EN61000-4-2 Air Gap Discharge and ±8KV EN61000-4-2 Contact Discharge.
The ZT3221E and ZT3223E features the AUTOGREEN (patent pending) proprietary function which automatically powers down the on-chip regulated voltage converters and driver circuits when an RS-232 cable is disconnected from the host interface or when a connected peripheral device is turned off.



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) ....±100mA

Input Voltages
TxIN, $\overline{\text{GREEN}}$, $\overline{\text{SHUTDOWN}}$, $\overline{\text{EN}}$ .... -0.3V to +6.0V
RxIN .... ±25V

Output Voltages
TxOUT .... ±15V
RxOUT, $\overline{\text{IDLE}}$ .... -0.3V to (V_{CC} +0.3V)

Short-Circuit Duration
TxOUT ....Continuous
Operating Temperature .... -40°C to +85°C
Storage Temperature .... -65°C to +150°C

Power Dissipation Per Package
16-pin SSOP (derate 7.20mW/°C above +70°C) ….584mW
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
16-pin PDIP (derate 11.20mW/°C above +70°C) ….896mW
16-pin QFN (derate 24mW/°C above +70°C) 2W
18-pin PDIP (derate 12.60mW/°C above +70°C) ….962mW
18-pin WSOIC (derate 11.10mW/°C above +70°C) .850mW

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} = +3.0V to +5.0V, T_A = T_{min} to T_{max}, C1 to C4 = 0.1 μF, typical values apply at V_{CC} = +3.3V or +5.0V and T_A = 25°C.

Parameter	Condition	Min	Typ	Max	Units
TTL Logic Input	T1IN, T2IN, $\overline{GREEN}$, $\overline{SHUTDOWN}$, $\overline{EN}$				
TTL Logic Output	R1OUT, R2OUT, $\overline{IDLE}$				
RS-232 Input	R1IN, R2IN				
RS-232 Output	T1OUT, T2OUT				
Charge Pump Pin	C1P, C1N, C2P, C2N				
Power Pin	V_{CC}, V_{GND}, V_{DD}, V_{SS}				
Charge Pump Caps	C1P, C1N, C2P, C2N	0.1	0.1	1	μF
Temp 0°C to +70°C	Commercial Grade	0	+25	+70	°C
Temp –40°C to +85°C	Industrial Grade	–40	+25	+85	°C
V_{CC} Voltage Range	V_{CC} = +5.0V Supply	4.5	5	5.5	V
	V_{CC} = +3.3V Supply	3	3.3	3.6	V
Supply Current	TTL Inputs = V_{CC}/GND, RS-232 Input = float, V_{CC} = 3.3V (For ZT3220E, ZT3222E, ZT3232E and ZT1385E)		0.5	1	mA
Supply Current, AUTOGREEN Disabled	$\overline{GREEN}$ = V_{CC}, (For ZT3221E and ZT3223E); $\overline{SHUTDOWN}$ = V_{CC}, (For ZT3221E, ZT3222E, ZT1385E and ZT3223E), TTL Inputs = V_{CC}/GND, RS-232 Input = float, V_{CC} = 3.3V		0.5	1	mA
Supply Current, AUTOGREEN Enabled	$\overline{GREEN}$ = GND, (For ZT3221E and ZT3223E); $\overline{SHUTDOWN}$ = V_{CC}, (For ZT3221E, ZT3222E, ZT1385E and ZT3223E), TTL Inputs = V_{CC}/GND, RS-232 Input = float, V_{CC} = 3.3V		1	10	μA
Supply Current, SHUTDOWN Enabled	$\overline{GREEN}$ = V_{CC}/GND, (For ZT3221E and ZT3223E); $\overline{SHUTDOWN}$ = GND, (For ZT3221E, ZT3222E, ZT1385E and ZT3223E), TTL Inputs = V_{CC}/GND, RS-232 Inputs = float, V_{CC} = 3.3V		1	10	μA
TTL LOGIC Input					
Input Threshold Low				0.8	V
Input Threshold High	V_{CC} = +5.0V Supply	2.4			V
Input Threshold High	V_{CC} = +3.3V Supply	2			V
Input Hysteresis			0.5		V
Input Leakage Current	V_{IN} = V_{CC} and GND, TIN, $\overline{EN}$, $\overline{GREEN}$, $\overline{SHUTDOWN}$		±0.01	±1	μA
Input Leakage Current	V_{IN} = V_{CC} and GND, TIN (For ZT1385E)		50	200	μA
TTL LOGIC Output					
Output Voltage Low	I_{OUT} = 1.6mA			0.4	V
Output Voltage High	I_{OUT} = –1.0mA	V_{CC} –0.6	V_{CC} –0.1		V
Output Leakage Current	Receiver Outputs Disabled, V_{OUT} = V_{CC} or GND, $\overline{SHUTDOWN}$ = GND, $\overline{EN}$ = V_{CC}		±0.05	±10	μA
Receiver Input					
Input Voltage Range	T_A = T_{min} – T_{max}	–25		25	V
Input Threshold Low	T_A = 25°C, V_{CC} = 5.0V	0.8	1.5		V
	T_A = 25°C, V_{CC} = 3.3V	0.6	1.2		V
Input Threshold High	T_A = 25°C			2.4	V
Input Hysteresis	T_A = 25°C		0.5		V
Input Resistance	V_{IN} = ±25V, T_A = 25°C	3		7	KΩ
Transmitter Output					
Output Voltage Swing	R_L = 3KΩ, All Outputs are loaded		±5		V
Output Resistance	V_{CC} = V_{DD} = V_{SS} = GND, V_{OUT} = ±2V	300			Ω
Output Short-Circuit Current	V_{OUT} = GND			±60	mA
Output Leakage Current	Transmitter Disabled, V_{OUT} = ±12V		±5		μA

Parameter	Condition	Min	Typ	Max	Units
Timing Characteristics Maximum Data Rate Refers to Figure 1 and 2.	R_L = 3KΩ, C_L = 1000pF, One Transmitter Switching, T_A = 25°C	250			Kbps
Transition-Region Slew Rate	R_L = 3~7KΩ, C_L = 150pF to 1000pF, One Transmitter Switching, T_A = 25°C, Measured from 3V to －3V or －3V to 3V	6		30	V/μs
Receiver Propagation t_{PLH} Receiver Propagation t_{PHL} Receiver Skew Receiver Output Enable Time Receiver Output Disable Time	C_L = 150pF C_L = 150pF t_{PHL} － t_{PLH} For ZT3220E, ZT3221E, ZT3222E, ZT3223E only For ZT3220E, ZT3221E, ZT3222E, ZT3223E only		0.15 0.15 50 0.2 0.2		μs μs ns μs μs
AUTOGREEN Timing Receiver Input to IDLE Output High Receiver Input to IDLE Output Low Power Save Mode to Transmitter Enabled	For ZT3221E and ZT3223E only For ZT3221E and ZT3223E only For ZT3221E and ZT3223E only		1 30 100		μs μs μs
ESD Tolerance ESD HBM EN61000-4-2 Contact Discharge EN61000-4-2 Air Gap Discharge	RS-232 Inputs and Outputs RS-232 Inputs and Outputs RS-232 Inputs and Outputs		±15 ±8 ±15		KV KV KV

3 Pin Description

ZT3220E/ZT3221E/ZT3222E/ZT3232E/ZT1385E/ZT3223E

Pin Number								Pin Name	Pin Description
ZT3220E	ZT3221E	ZT3222E		ZT3232E	ZT1385E		ZT3223E		
16 Pins	16 Pins	18 Pins	20 Pins	16 Pins*	18 Pins	20 Pins	20 Pins		
1	1	1	1	–	–	–	1	$\overline{\text{EN}}$	Receiver Enable. Logic low for Normal operation. Logic high to force the receiver outputs into high impedance state
2	2	2	2	1	2	2	2	C1+	Positive terminal of the boostrapped voltage switch capacitor
3	3	3	3	2	3	3	3	V+	Regulated +5.4V output generated by the voltage converter
4	4	4	4	3	4	4	4	C1-	Negative terminal of the boostrapped voltage switch capacitor
5	5	5	5	4	5	5	5	C2+	Positive terminal of the inverted voltage switch capacitor
7	7	7	7	6	7	7	7	V-	Regulated –5.7V output generated by the voltage converter
6	6	6	6	5	6	6	6	C2-	Negative terminal of the inverted voltage switch capacitor
8	8	14	16	13	14	16	16	R1 IN	First RS232 receiver input
–	–	9	9	8	9	9	9	R2 IN	Second RS232 receiver input
9	9	13	15	12	13	15	15	R1 OUT	First TTL/CMOS receiver output
–	–	10	10	9	10	12	10	R2 OUT	Second TTL/CMOS receiver output
11	11	12	13	11	12	14	13	T1 IN	First TTL/CMOS transmitter input
–	–	11	12	10	11	13	12	T2 IN	Second TTL/CMOS transmitter input
13	13	15	17	14	15	17	17	T1 OUT	First RS232 transmitter output
–	–	8	8	7	8	8	8	T2 OUT	Second RS232 transmitter output
–	10	–	–	–	–	–	11	$\overline{\text{IDLE}}$	TTL/CMOS output indicating AUTOGREEN or SHUTDOWN status
16	16	18	20	–	18	20	20	$\overline{\text{SHUTDOWN}}$	Shutdown control. A logic LOW to disable drivers and voltage converter
–	12	–	–	–	–	–	14	$\overline{\text{GREEN}}$	A logic HIGH to override AUTO-GREEN circuitry keeping transmitters ON. ($\overline{\text{SHUTDOWN}}$ must be HIGH)
14	14	16	18	15	16	18	18	GND	Ground
15	15	17	19	16	17	19	19	VCC	+3V to +5.5V Supply Voltage
10,12	–	–	11,14	–	1	1,10,11	–	NC	No connect

*Pin-outs for NSOIC, WSOIC, SSOP and TSSOP packages only.

4 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.

Controlled Power-Down

The ZT3220E, ZT3221E, ZT3222E, and ZT3223E have a low-power shutdown mode controlled by the $\overline{\text{SHUTDOWN}}$ pin. During shutdown the driver output and the switch-capacitor regulated voltage converter are disabled with the supply current falls to less than 1 μA.

The ZT3221E and ZT3223E use ASIX’ s patent pending $\overline{\text{AUTOGREEN}}$ circuitry to set/reset latches, which enable the circuit shutdown function when a RS232 cable is disconnected or when the peripheral is turned off and reduce the power supply drain to a 1 μA supply current. When a RS232 cable is connected or when the peripheral is enabled, the devices will automatically become active again.

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 circuity.

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 includes 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.

ASIX's RS232 transceivers meets and exceeds the minimum criteria for EN61000-4-2 with ±15KV for Air Gap Discharge and ±8KV for Contact Discharge.

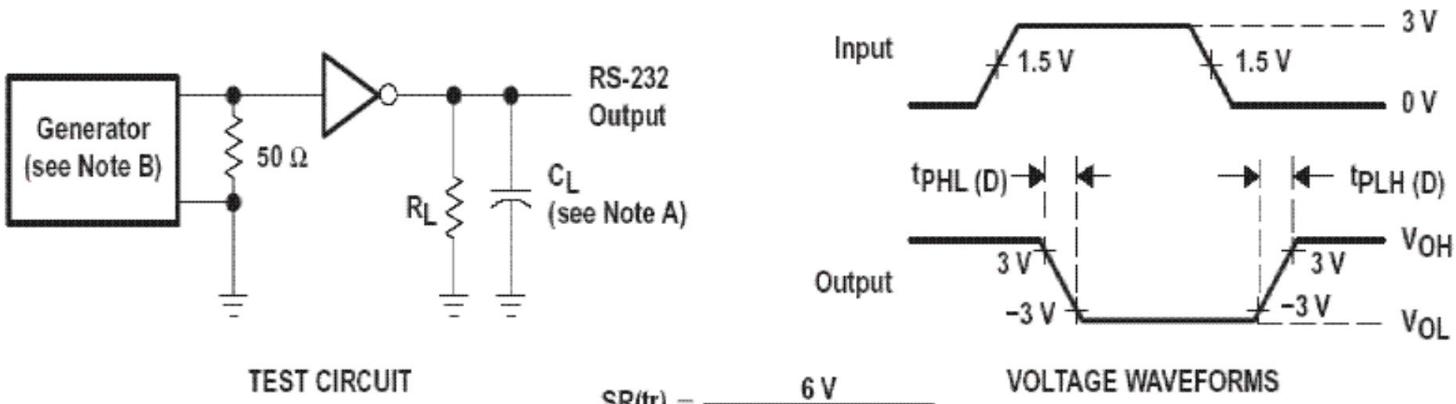
Operation Status	$\overline{GREEN}$	$\overline{SHUTDOWN}$	EN	Signal at R_XIN	$\overline{IDLE}$	T_XOUT	R_XOUT
Shutdown	don't care	0	0	present	1	tri-state	active
	don't care	0	0	not present	0	tri-state	active
	don't' care	0	1	present	1	tri-state	tri-state
	don't' care	0	1	not present	0	tri-state	tri-state
Normal without $\overline{GREEN}$	1	1	0	present	1	active	active
	1	1	0	not present	0	active	active
	1	1	1	present	1	active	tri-state
	1	1	1	not present	0	active	tri-state
Normal with $\overline{GREEN}$	0	1	0	present	1	active	active
	0	1	0	not present	0	tri-state	tri-state
	0	1	1	present	1	active	tri-state
	0	1	1	not present	0	tri-state	tri-state

Table 1. ZT32xxE Truth Table

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 at 250Kbps. The RS-232 output on channel 2 also shows good signal integrity while at the high data rates, which allow the receiver to process the signal will 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 ±15KV ESD immunity.



$$SR(tr) = \frac{6\ V}{t_{PHL\ (D)} \text{ or } t_{PLH\ (D)}}$$

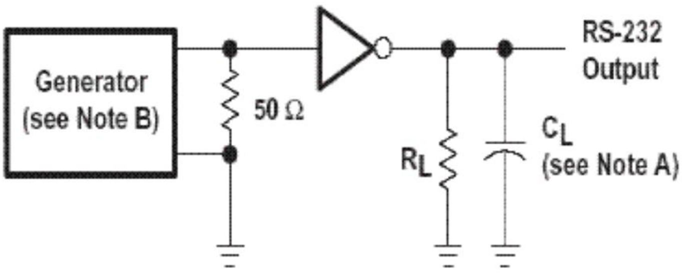
Driver Transition-Region Slew Rate Test Circuit

Notes:

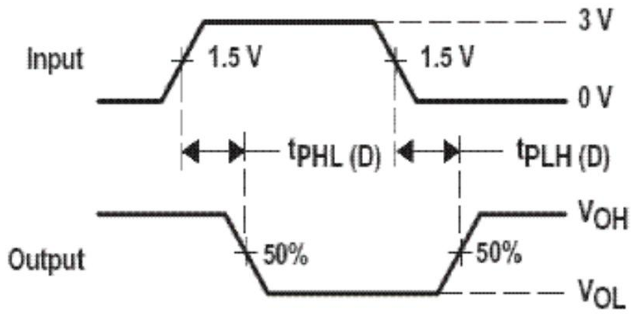
A. R_L = 3~7 KΩ , C_L = 150pF to 1000pF, One Driver Switching, T_A = 25°C,
Measured from +3V to -3V or -3V to +3V.

B. The pulse generator had the following characteristics:
PRR = 250 Kbps, Zo = 50Ω, 50% duty cycle, T_r & T_f <= 10ns.

C. $\overline{\text{SHUTDOWN}}$ = V_{CC} when applicable.



TEST CIRCUIT



VOLTAGE WAVEFORMS

Driver Propagation (t_{PHL} & t_{PLH}) Test Circuit

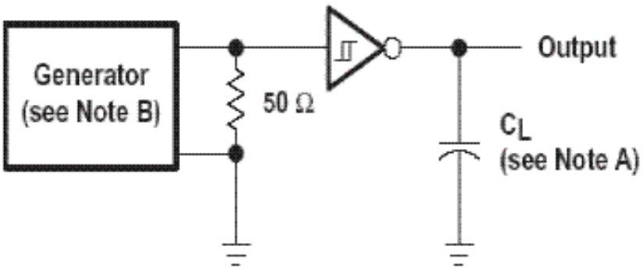
Notes:

A. All drivers loaded with R_L = 3KΩ , C_L = 1000pF.

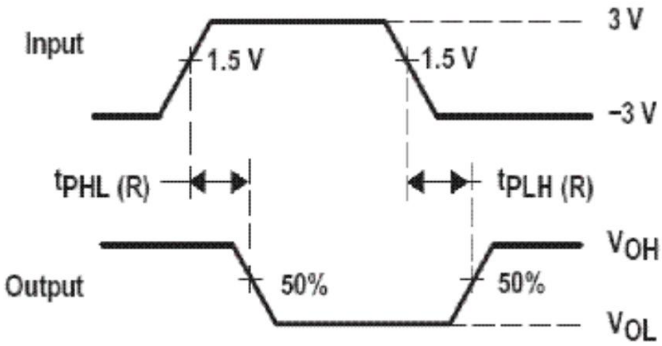
B. The pulse generator had the following characteristics:

PRR = 250 Kbps, Zo = 50Ω, 50% duty cycle, T_r & T_f <= 10ns.

C. $\overline{\text{SHUTDOWN}}$ = V_{CC} when applicable.



TEST CIRCUIT



VOLTAGE WAVEFORMS

Receiver Propagation Delay Times Test Circuit

Notes:

A. C_L = 150pF, including probe and jig capacitance.

B. The pulse generator had the following characteristics:

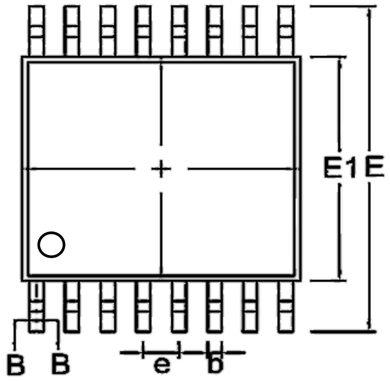
PRR = 250 Kbps, Zo = 50Ω, 50% duty cycle, T_r & T_f <= 10ns.

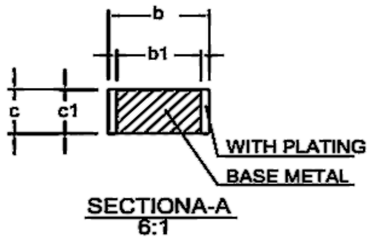
C. $\overline{\text{SHUTDOWN}}$ = V_{CC} when applicable.

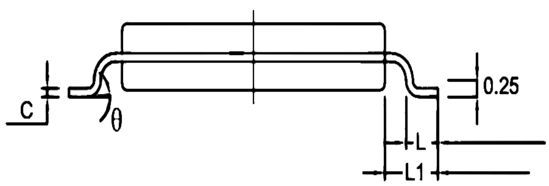
Order information

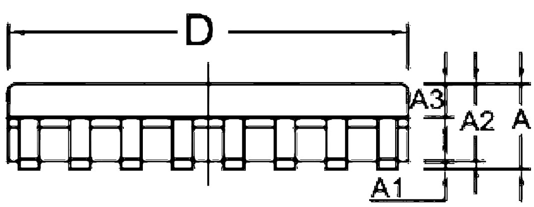
Order Number	Package	Package Quantity	Marking On The park
ZT3232ECA-TUDI	SSOP16	Tape,Reel,2500	ZT3232ECA
ZT3232ECN-TUDI	SOP16	Tape,Reel,2500	ZT3232ECN
ZT3232ECT-TUDI	SMD16	Tape,Reel,1000	ZT3232ECT
ZT3232ECY-TUDI	TSSOP16	Tape,Reel,2500	ZT3232ECY
ZT3232EEA-TUDI	SSOP16	Tape,Reel,2500	ZT3232EEA
ZT3232EEN-TUDI	SOP16	Tape,Reel,2500	ZT3232EEN
ZT3232EET-TUDI	SMD16	Tape,Reel,1000	ZT3232EET
ZT3232EEY-TUDI	TSSOP16	Tape,Reel,2500	ZT3232EEY
ZT3232LEEA-TUDI	SSOP16	Tape,Reel,2500	ZT3232LEEA
ZT3232LEEN-TUDI	SOP16	Tape,Reel,2500	ZT3232LEEN
ZT3232LEET-TUDI	SMD16	Tape,Reel,1000	ZT3232LEET
ZT3232LEEY-TUDI	TSSOP16	Tape,Reel,2500	ZT3232LEEY

Package TSSOP16



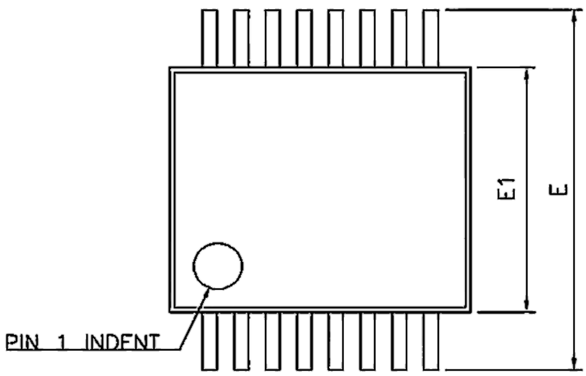


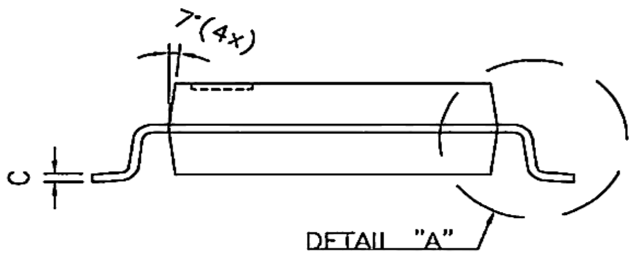


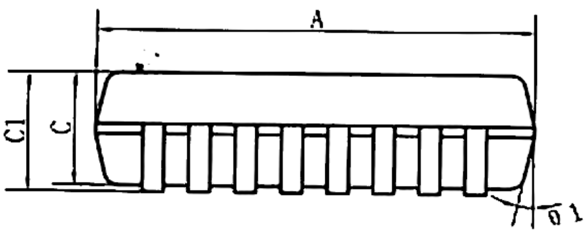


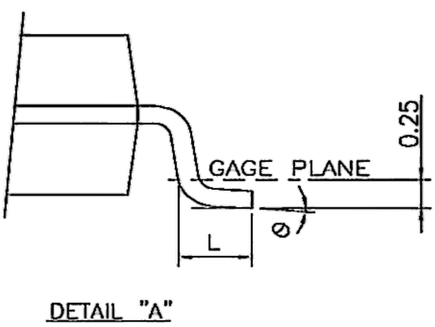
SIZE / SYMBOL	MIN./mm	TYP./mm	MAX./mm
A	--	--	1.20
A1	0.05		0.15
A2	0.90	1.00	1.05
b	0.20	--	0.30
b1	0.19	0.22	0.25
C	0.110	0.127	0.145
cl	0.12	0.13	0.14
D	4.86	4.96	5.06
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00BSC		
	0°	--	8°

Package SSOP16



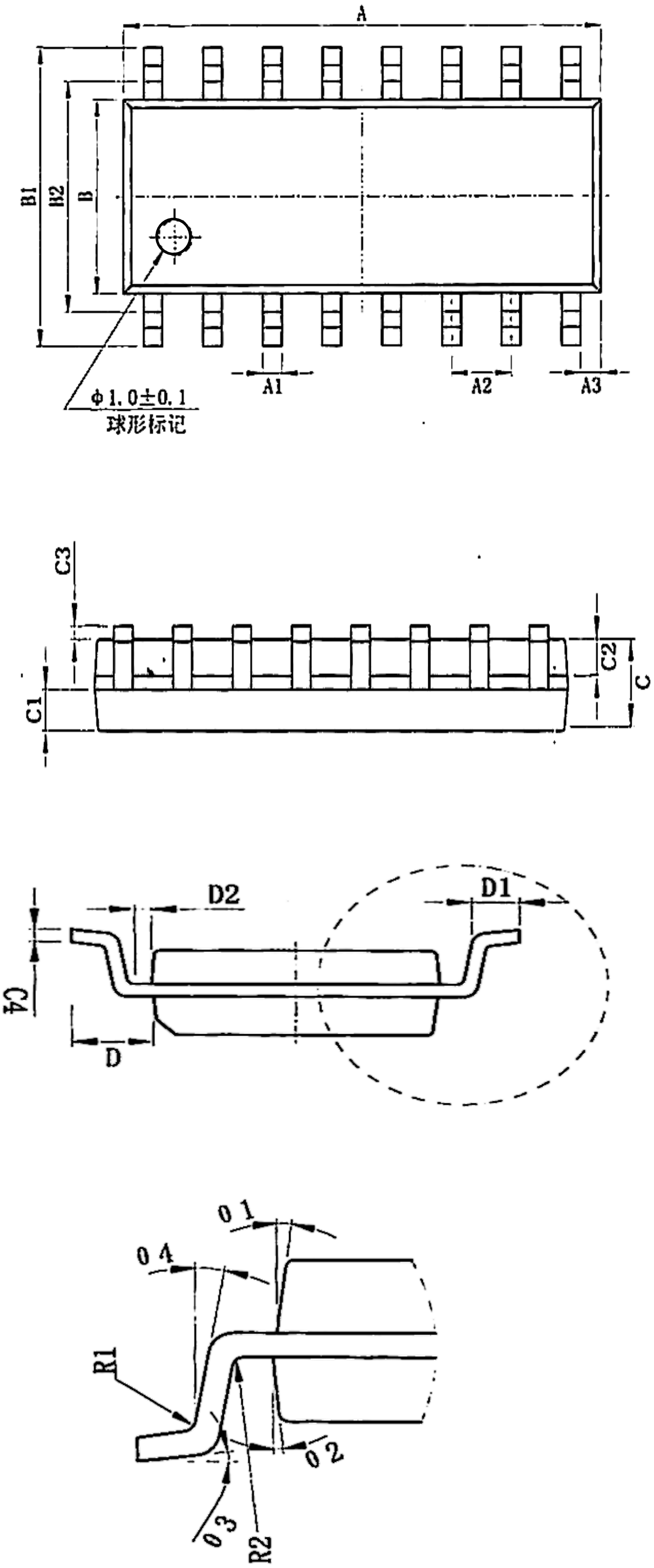






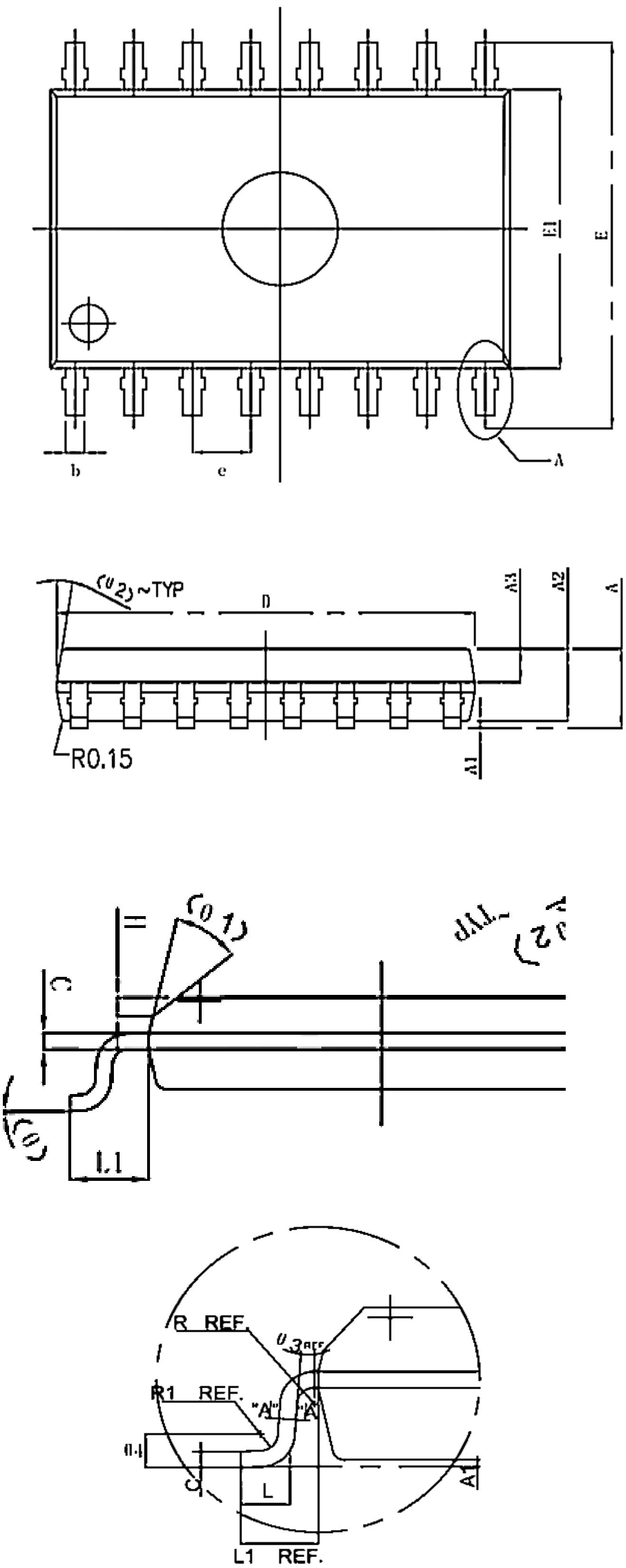
SIZE / SYMBOL	MIN/mm	MAX/mm
A	6.15	6.25
A1	0.30TYP	
A2	0.65TYP	
A3	0.675TYP	
B	5.25	5.35
B1	7.65	7.95
B2	0.60	0.80
C	1.70	1.80
C1	1.75	1.95
C2	0.799	
C3	0.152	
C4	0.172	
H	0.05	0.15
θ	12°TYP4	
01	12°TYP4	
02	10°TYP	
03	0°~8°	
R	0.20°TYP	
R	0.15°TYP	

Package 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°
θ1	45° TYP	
02	12° TYP	
03	0°	8°
04	0°	10°

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