19-2667; Rev 1; 1/03

MAXIM

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

General Description

The MAX3322E/MAX3323E 3.0V to 5.5V powered EIA/TIA-232 and V.28/V.24 communications interfaces are designed for multidrop applications with low power requirements, high data-rate capabilities, and enhanced electrostatic discharge (ESD) protection. All RS-232 inputs and outputs are protected to ±15kV using the IEC 1000-4-2 Air-Gap Discharge method, ±8kV using the IEC 1000-4-2 Contact Discharge method, and ±15kV using the Human Body Model.

The MAX3322E/MAX3323E have pin-selectable 5kΩ/high-impedance RS-232 receivers. These devices are capable of receiving data in high-impedance mode. In multidrop applications, one receiver has a 5kΩ input resistance, while the other receivers are high impedance to ensure the RS-232 standard is observed. Logic control permits selection of the functional mode: high impedance or RS-232 standard load. The transmitters are enabled by logic control to allow the multiplexing of the inputs to a single UART.

A proprietary low-dropout transmitter output stage enables true RS-232 performance from a 3.0V to 5.5V supply with a dual charge pump. The charge pump requires only four small 0.1µF capacitors for operation from a 3.3V supply. The MAX3322E/MAX3323E are capable of running at data rates up to 250kbps while maintaining RS-232-compliant output levels. The MAX3322E/MAX3323E have a unique V_L pin that allows operation in mixed-logic voltage systems. Both input and output logic levels are pin programmable through the V_L pin.

The MAX3322E is a 2Tx/2Rx device for hardware handshaking in standard RS-232 mode, and the MAX3323E is a 1Tx/1Rx, required in most multidrop applications.

The MAX3322E is offered in a space-saving TSSOP package. The MAX3323E is offered in 16-pin DIP and space-saving TSSOP packages.

Applications

Bar-Code Scanners

Video Security

Industrial Data Acquisition

Data Splitters

Typical Operating Circuit and Functional Diagram appear at end of data sheet.

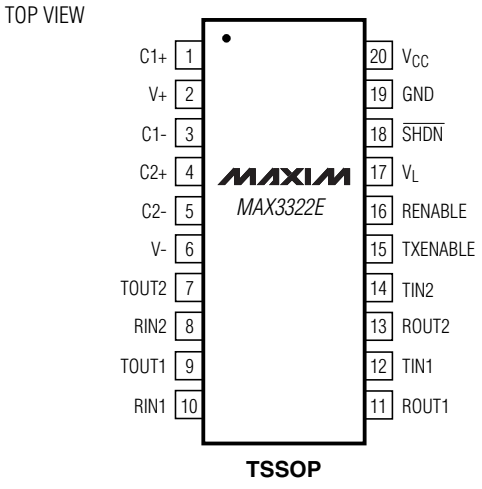
Features

- **Pin-Selectable 5kΩ/High-Impedance Receivers**
- **Transmitter Outputs Three-Stated by Logic Control**
- **V_L Pin for Compatibility with Mixed Voltage Systems**
- **1Tx/1Rx (MAX3323E) or 2Tx/2Rx (MAX3322E) Versions**
- **250kbps Data Rate**
- **1µA Low-Power Shutdown**
- **High ESD Protection for RS-232 I/O Pins**
  - **±15kV—Human Body Model**
  - **±8kV—IEC 1000-4-2 Contact Discharge**
  - **±15kV—IEC 1000-4-2 Air-Gap Discharge**

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX3322EEUP	-40°C to +85°C	20 TSSOP
MAX3323EEUE	-40°C to +85°C	16 TSSOP
MAX3323EEPE	-40°C to +85°C	16 DIP

Pin Configurations



TSSOP

Pin Configurations continued at end of data sheet.

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

ABSOLUTE MAXIMUM RATINGS

All Voltages Referenced to GND
V_{CC}, V_L .....-0.3V to +6V
V+ (Note 1).....(V_{CC} - 0.3V) to +7V
V- (Note 1) .....+0.3V to -7V
V+ + IV-I (Note 1).....+13V
Input Voltages
TIN_, RENABLE, TXENABLE, $\overline{SHDN}$.....-0.3V to +6V
RIN_ .....±25V
Output Voltages
TOUT_.....±13.2V
ROUT_.....-0.3V to (V_L + 0.3V)

Short-Circuit Duration TOUT_ to GND.....Continuous
Continuous Power Dissipation (T_A = +70°C)
16-Pin DIP (derate 10.5mW/°C above +70°C).....842mW
16-Pin TSSOP (derate 9.4mW/°C above +70°C) 755mW
20-Pin TSSOP(derate 11mW/°C above +70°C) 879mW
Operating Temperature Range
MAX3322E/MAX3323E .....-40°C to +85°C
Junction Temperature ..... +150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature (soldering, 10s) .....+300°C

Note 1: V+ and V- can have maximum magnitudes of 7V, but their absolute difference cannot exceed 13V.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC ELECTRICAL CHARACTERISTICS

(V_{CC} = 3.0V to 5.5V, V_L = 1.65V to 5.5V, C1–C4 = 0.1µF, tested at +3.3V ±10%; C1 = 0.047µF, C2 = C3 = C4 = 0.33µF, tested at +5V ±10%; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = V_L = 3.3V and T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
Supply Current Normal Operation	I_{CC}	$\overline{SHDN}$ = V_L, no load		1		mA
Supply Current in Shutdown	$I_{CC(\overline{SHDN})}$	$\overline{SHDN}$ = 0V, no load		1	10	µA
TRANSMITTER LOGIC INPUTS						
Input Logic Threshold Low					0.4	V
Input Logic Threshold High		$V_L \le 1.8V$	V_L - 0.4			V
		$V_L > 1.8V$	2/3 x V_L			
Transmitter Input Hysteresis				0.2		V
Input Leakage Current	I_{IL}			±0.01	±1	µA
LOGIC INPUTS (TXENABLE, RENABLE, $\overline{SHDN}$)						
Input Logic Threshold Low					0.4	V
Input Logic Threshold High			2/3 x V_L			V
Input Leakage Current				±0.01	±1	µA
RECEIVER OUTPUTS						
Output Leakage Current	I_{OL}	Receivers disabled, $\overline{SHDN}$ = 0V		±0.05	±10	µA
Output Voltage Low	V_{OL}	I_{OUT} = 1.6mA, $V_L > 1.8V$			0.4	V
		I_{OUT} = 1mA, $V_L \le 1.8V$			0.4	
Output Voltage High	V_{OH}	I_{OUT} = -1mA, $V_L > 1.8V$	V_L - 0.4	V_L - 0.1		V
		I_{OUT} = -500µA, $V_L \le 1.8V$	V_L - 0.4	V_L- 0.1		
RECEIVER INPUTS						
Input Voltage Range	V_{RIN}		-25		+25	V
Input Threshold Low		V_L = 1.65V	0.25	0.6		V
		V_L = 3.3V	0.6	1.2		
		V_L = 5.0V	0.8	1.5		

DC ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = 3.0V to 5.5V, V_L = 1.65V to 5.5V, C1–C4 = 0.1µF, tested at +3.3V ±10%; C1 = 0.047µF, C2 = C3 = C4 = 0.33µF, tested at +5V ±10%; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = V_L = 3.3V and T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Threshold High		V_L = 1.65V		1	1.4	V
		V_L = 3.3V		1.5	2.4	
		V_L = 5.0V		1.8	2.4	
Input Hysteresis				0.35		V
Input Resistance	R_{IN}	RENABLE = 1	3	5	7	kΩ
		RENABLE = 0 or $\overline{SHDN}$ = 0V, R_{IN} from -13V to +13V	1			MΩ
TRANSMITTER OUTPUTS						
Output Voltage Swing		All transmitter outputs loaded with 3kΩ to ground	±5	±5.4		V
Output Resistance		V_{CC} = V+ = V- = 0, TOUT_ = ±2V, TXENABLE = 1	300	10M		Ω
Output Short-Circuit Current		V_{OUT} = 0V			±60	mA
Output Leakage Current		V_{OUT} = ±12V, transmitters disabled			±25	µA
ESD PROTECTION						
RIN, TOUT		Human Body Model		±15		kV
		IEC 1000-4-2 Air-Gap Discharge		±15		
		IEC 1000-4-2 Contact Discharge		±8		

TIMING CHARACTERISTICS

(V_{CC} = 3.0V to 5.5V, V_L = 1.65V to 5.5V, C1–C4 = 0.1µF, tested at +3.3V ±10%; C1 = 0.047µF, C2 = C3 = C4 = 0.33µF, tested at +5V ±10%; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = V_L = 3.3V and T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Maximum Data Rate		R_L = 3kΩ, C_L = 1000pF, one transmitter switching	250			kbps
Receiver Propagation Delay	t_{PHL}	RIN_ to ROUT_, C_L = 30pF, V_L = 3.3V, Figure 2		150		ns
	t_{PLH}			180		
Transmitter Propagation Delay	t_{PHL}	TIN_ to TOUT_, R_L = 3kΩ, C_L = 1000pF, Figure 1		0.6		µs
	t_{PLH}			0.7		
Time to Enter Three-State on Tx		(Note 2)		10	50	µs
Time to Exit Three-State on Tx		(Note 2)		3	50	µs
Time to Enable Resistor		(Note 2)		0.4	10	µs
Time to Disable Resistor		(Note 2)		0.2	10	µs
Time to Enter Shutdown				50		µs
Time to Exit Shutdown				50		µs
Transmitter Skew				100		ns
Receiver Skew				30		ns
Transition Region Slew Rate		R_L = 3kΩ to 7kΩ, C_L = 1000pF, measured from +3V to -3V or vice versa	6		30	V/µs

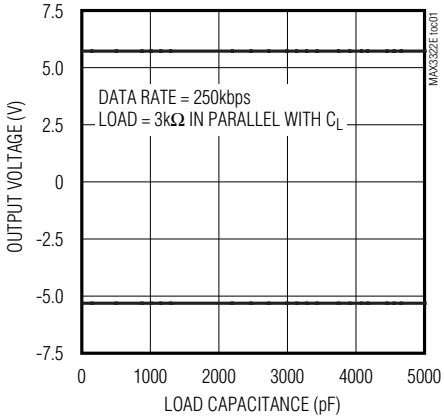
Note 2: Guaranteed by design. Not production tested.

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

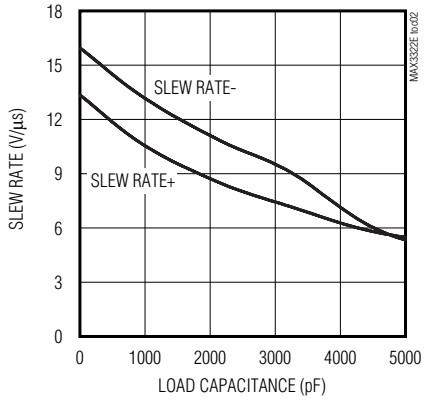
Typical Operating Characteristics

(V_{CC} = 3.3V, V_L = 3.3V, C1–C4 = 0.1µF, T_A = +25°C.)

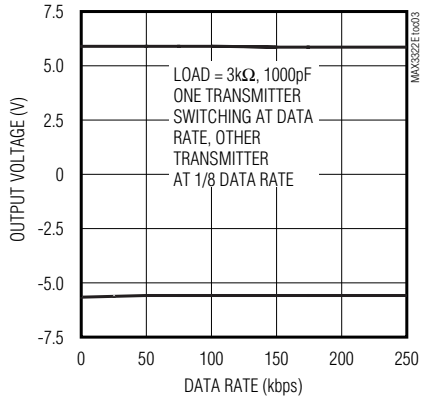
TRANSMITTER OUTPUT VOLTAGE vs. LOAD CAPACITANCE



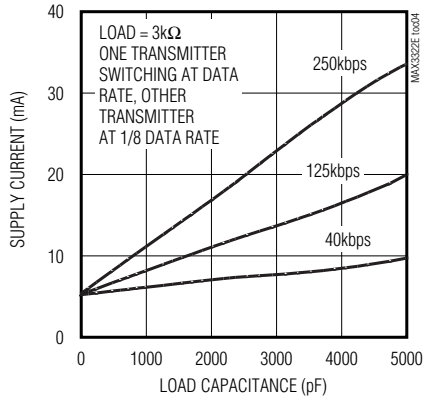
SLEW RATE vs. LOAD CAPACITANCE



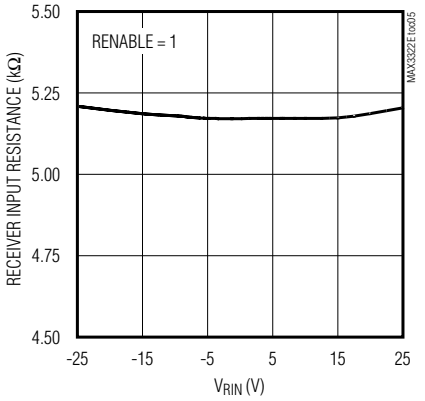
TRANSMITTER OUTPUT VOLTAGE vs. DATA RATE



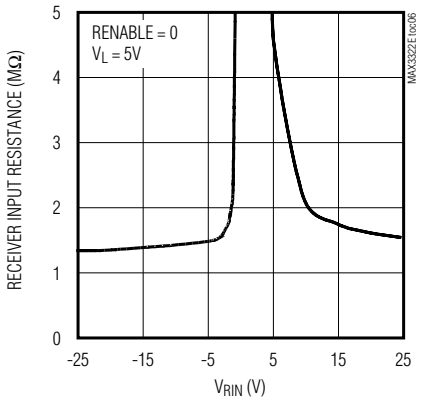
SUPPLY CURRENT vs. LOAD CAPACITANCE



RECEIVER INPUT RESISTANCE vs. INPUT VOLTAGE RANGE



RECEIVER INPUT RESISTANCE vs. INPUT VOLTAGE RANGE



Pin Description

PIN		NAME	FUNCTION
MAX3322E	MAX3323E		
1	1	C1+	Positive Terminal of the Voltage-Doubler Charge-Pump Capacitor
2	2	V+	+5.5V Generated by the Charge Pump
3	3	C1-	Negative Terminal of the Voltage-Doubler Charge-Pump Capacitor
4	4	C2+	Positive Terminal of the Inverting Charge-Pump Capacitor
5	5	C2-	Negative Terminal of the Inverting Charge-Pump Capacitor
6	6	V-	-5.5V Generated by the Charge Pump
7, 9	7	TOUT_	Transmitter Output
8, 10	8	RIN_	Receiver Input
11, 13	9	ROUT_	Receiver Output
12, 14	10	TIN_	Transmitter Input
15	11	TXENABLE	Transmitter Enable. Drive TXENABLE high to enable transmitter. Drive TXENABLE low to put transmitter into high impedance.
16	12	RENABLE	Receiver Termination Enable. Drive RENABLE high for normal RS-232 5kΩ termination. Drive RENABLE low to make receiver inputs high impedance. In either case, the receiver and its output are enabled.
17	13	V_L	Logic-Level Supply. All CMOS inputs and outputs are referred to V_L, which is from 1.65V to 5.5V.
18	14	$\overline{SHDN}$	Shutdown Input. Drive $\overline{SHDN}$ low to put device into shutdown mode. Drive $\overline{SHDN}$ high for normal operation. In shutdown, all transmitter and receiver outputs are in three-state; receiver inputs are high impedance.
19	15	GND	Ground
20	16	V_{CC}	+3V to +5.5V Input Voltage. Bypass V_{CC} to GND with a 0.1µF capacitor.

Detailed Description

The MAX3322E/MAX3323E are RS-232 transceivers for multidrop applications (i.e., multiple-receiver operation). The devices are pin selectable between standard RS-232 operation with 5kΩ input resistance receivers or high-input-impedance receivers. Receivers of the MAX3322E/MAX3323E remain active in both modes of operation. In multidrop applications, a selected receiver is set at a 5kΩ input resistance, while the others are high-input impedance, maintaining RS-232 standards. Logic control permits selection of the functional mode: high impedance or normal load. The transmitters are enabled by logic control to allow transmission-line sharing.

The logic supply input (V_L) controls the levels of the system's I/O and works from 1.65V to 5.5V, providing compatibility with lower microprocessor I/O voltages. The transmitters are inverting level translators that convert CMOS logic levels into RS-232-compatible levels. They guarantee 250kbps with loads of R_L = 3kΩ and C_L = 1000pF. The transmitters are enabled or disabled (three-stated) by the logic control TXENABLE, which manages transmission-line sharing in multidrop applications. When TXENABLE is high, the transmitter is enabled. When TXENABLE is low, the transmitter is put in high-impedance state. The receivers can be used in two conditions, selectable by the logic control RENABLE. When RENABLE is high, the internal 5kΩ resistor is connected across receiver input and ground. When RENABLE is low, the receiver input is high impedance, while maintaining receiving capability.

In shutdown mode, all transmitter and receiver outputs are three-stated, receiver inputs are in high impedance, the charge pump is turned off, V+ decays to V_{CC}, and V- decays to ground. ESD protection structures are incorporated in all pins to protect against ESD events encountered during handling and assembly. The receiver inputs and the transmitter outputs have ±15kV ESD structure implementation.

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

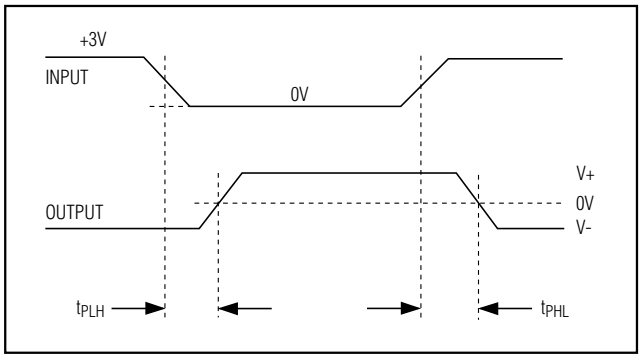


Figure 1. Transmitter Propagation-Delay Timing

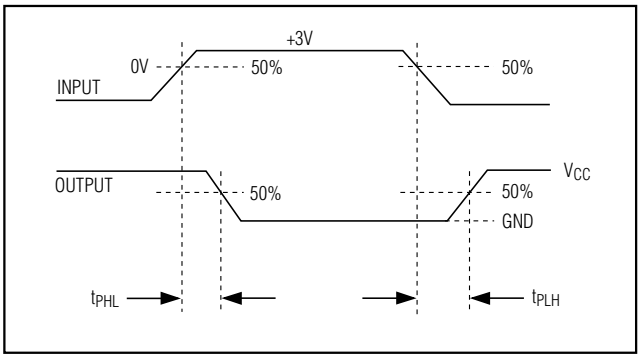


Figure 2. Receiver Propagation-Delay Timing

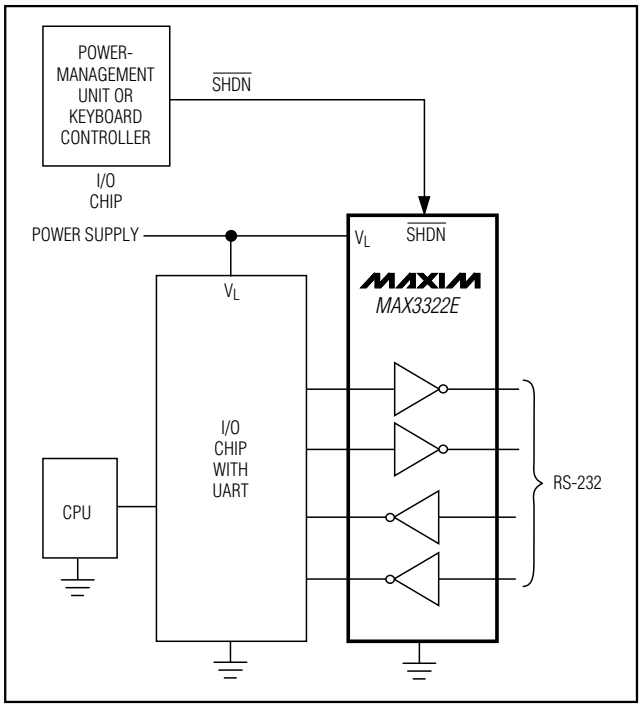


Figure 3. Interface Under Control of PMU

Dual Charge-Pump Voltage Converter

The MAX3322E/MAX3323Es' internal power supply consists of a regulated dual charge pump that provides output voltages of +5.5V (doubling charge pump) and -5.5V (inverting charge pump), regardless of the input voltage (V_{CC}), over a +3.0V to +5.5V range. The charge pumps operate in a discontinuous mode: if the output voltages are less than 5.5V, the charge pumps are enabled; if the output voltages exceed 5.5V, the charge pumps are disabled. Each charge pump requires a flying capacitor (C1, C2) and reservoir capacitor (C3, C4) to generate the V+ and V- supplies. Because supply voltages can vary from +3V up to +5.5V, the selection of the capacitor values depends on the V_{CC} value. Table 2 shows minimum capacitor values.

RS-232 Transmitters

The transmitters are inverting level translators that convert CMOS-logic levels to 5.0V EIA/TIA-232 levels. The transmitters are enabled or disabled (three-stated) by the logic control TXENABLE, which manages transmission-line sharing in multidrop applications. When TXENABLE is high, the transmitter is enabled. When TXENABLE is low, the transmitter is put in a high-impedance state (see Table 1).

The MAX3322E/MAX3323Es' transmitters guarantee a 250kbps data rate with worst-case loads of 3kΩ in parallel with 1000pF, providing compatibility with PC-to-PC communication software (such as LapLink™). Transmitters can be paralleled to drive multiple receivers or mice. Figure 3 shows a complete system connection.

RS-232 Receivers

MAX3322E/MAX3323E receivers convert RS-232 signals to CMOS-logic output levels. The unique feature of the receivers is the switchable input resistance. The receiver input resistance can be 5kΩ or high impedance. These two conditions are selectable by the logic control RENABLE. When RENABLE is high, the 5kΩ resistor is connected across the receiver input and ground. When RENABLE is low, the receiver input is high impedance, maintaining receiving capability. This feature permits the design of multidrop applications, which observe RS-232 interface standards.

LapLink is a trademark of Traveling Software.

Table 1. Tx/Rx Logic

TXENABLE	RENABLE	$\overline{SHDN}$	TRANSMITTER OUTPUT	RECEIVER OUTPUT	RECEIVER INPUT
1	1	0	High-Z	High-Z	High-Z
1	1	1	Active	Enabled	5kΩ
1	0	0	High-Z	High-Z	High-Z
1	0	1	Active	Enabled	High-Z
0	1	0	High-Z	High-Z	High-Z
0	1	1	High-Z	Enabled	5kΩ
0	0	0	High-Z	High-Z	High-Z
0	0	1	High-Z	Enabled	High-Z

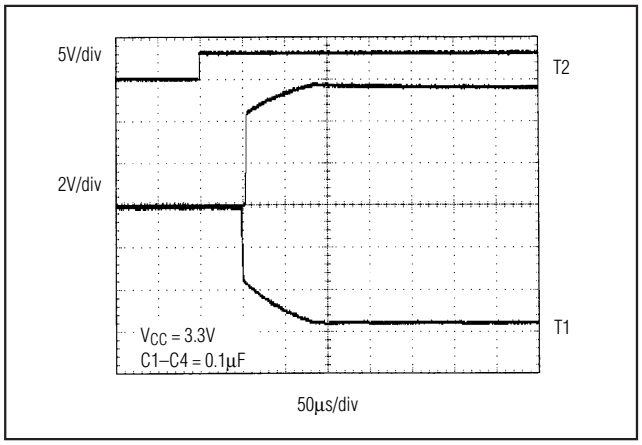


Figure 4. Transmitter Outputs when Exiting Shutdown

High-input impedance is guaranteed from -13.0V to +13.0V, when the receiver is in high-input-impedance mode. The receiver is able to withstand the RS-232 maximum input voltage of ±25V.

Shutdown Mode

Supply current falls to less than 10µA when the MAX3322E/MAX3323E are placed in shutdown mode (logic low). When in shutdown mode, the devices' charge pumps are turned off, V+ decays to V_{CC}, V- is pulled to ground, the transmitter outputs and the receiver outputs are disabled (high impedance), and the receiver inputs are in high impedance (Table 1). The device enters shutdown when V_L or V_{CC} is absent.

The time required to exit shutdown is typically 50µs, as shown in Figure 4. Connect $\overline{SHDN}$ to V_{CC} if shutdown mode is not used.

V_L Logic Supply Input

Unlike other RS-232 interface devices, in which the receiver outputs swing between 0 and V_{CC}, the MAX3322E/MAX3323E feature a separate logic supply input (V_L) that sets V_{OUT} for the receiver outputs and sets thresholds for the transmit and shutdown inputs. This feature allows a great deal of flexibility in interfacing to many types of systems with different logic levels. Connect this input to the host logic supply ($1.65V \le V_L \le 5.5V$).

±15kV ESD Protection

To protect the MAX3322E/MAX3323E against ESD, transmitters and receivers have extra protection against static electricity to protect the device up to ±15kV. The ESD structures withstand high ESD in all states: normal operation, shutdown, and powered down. ESD protection can be tested in various ways; the transmitter and receiver pins are characterized for protection to the following limits:

- ±15kV using the Human Body Model
- ±8kV using the IEC 1000-4-2 Contact Discharge method
- ±15kV using the IEC 1000-4-2 Air-Gap method

Note: ESD performance depends on many conditions. Contact Maxim for a reliability report that documents test setup, test methodology, and test results.

Human Body Model

Figure 5 shows the Human Body Model, and Figure 6 shows the current waveform it generates when discharged into a low impedance. This model consists of a 100pF capacitor charged to the ESD voltage of interest, which is then discharged into the test device through a 1.5kΩ resistor.

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

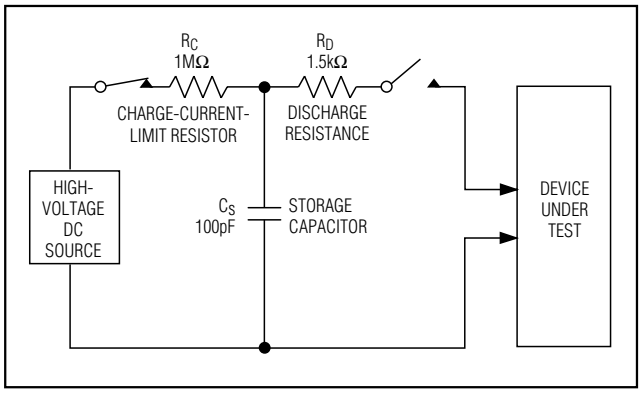


Figure 5. Human Body ESD Test Model

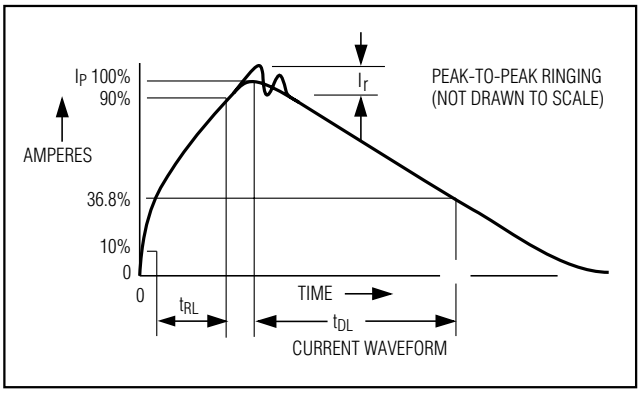


Figure 6. Human Body Model Current Waveform

IEC 1000-4-2

The IEC 1000-4-2 standard covers ESD testing and performance of finished equipment; it does not refer specifically to integrated circuits. The MAX3322E/MAX3323E help the user design equipment that meets level 4 of IEC 1000-4-2, without the need for additional ESD-protection components. The major difference between tests done using the Human Body Model and IEC 1000-4-2 is a higher peak current in IEC 1000-4-2, because series resistance is lower in the IEC 1000-4-2 model. Hence, the ESD withstand voltage measured to IEC 1000-4-2 is generally lower than that measured using the Human Body Model. Figure 7 shows the IEC 1000-4-2 model. Figure 8 shows the current waveform it generates when discharged into a low impedance. The Air-Gap Discharge test involves approaching the device with a charged probe. The Contact Discharge method connects the probe to the device before the probe is energized.

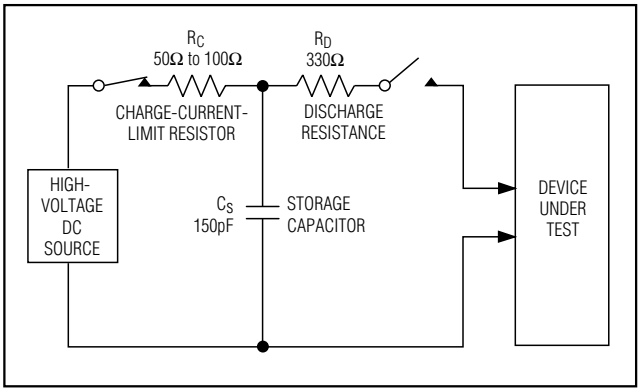


Figure 7. IEC 1000-4-2 ESD Test Model

Machine Model

The Machine Model for ESD tests all pins using a 200pF storage capacitor and zero discharge resistance. Its objective is to emulate the stress caused by contact that occurs with handling and assembly during manufacturing. All pins require this protection during manufacturing. Therefore, after PC board assembly, the Machine Model is less relevant to I/O ports.

Applications Information

The capacitor type used for C1–C4 is not critical for proper operation; polarized or nonpolarized capacitors can be used. The charge pump requires 0.1µF capacitors for 3.3V operation. For other supply voltages, see Table 2 for required capacitor values. Do not use values smaller than those listed in Table 2. Increasing the capacitor values (e.g., by a factor of 2) reduces ripple

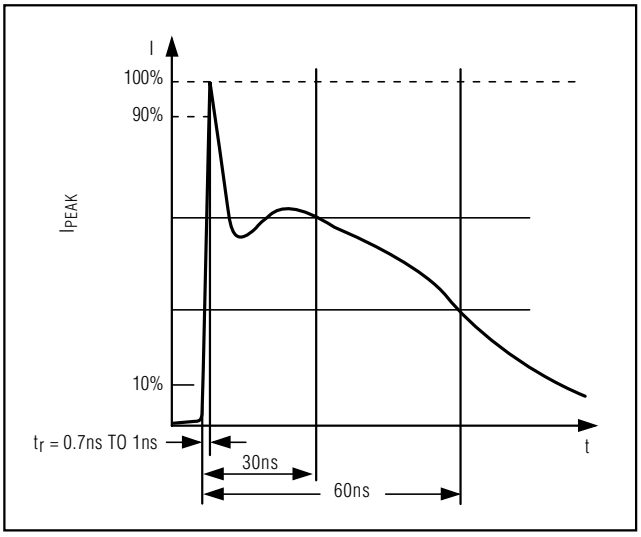


Figure 8. IEC 1000-4-2 ESD Generator Current Waveform

on the transmitter outputs and slightly reduces power consumption. The values of C2, C3, and C4 can be increased without changing C1's value. However, do not increase C1's value without also increasing the values of C2, C3, and C4 to maintain the proper ratios (C1 to the other capacitors).

When using the minimum required capacitor values, make sure the capacitor value does not degrade excessively with temperature. If in doubt, use capacitors with a larger nominal value. The capacitor's equivalent series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V-.

Table 2. Minimum Required Capacitor Values

V_{CC} (V)	C1 (µF)	C2, C3, C4 (µF)
3.0 to 3.6	0.1	0.1
4.5 to 5.5	0.047	0.33
3.0 to 5.5	0.22	1

Multidrop Applications

The MAX3323E connects to the RS-232 serial port of computer peripherals such as a bar-code scanner, video security controls, industrial multimeters, etc., and allows multiple devices to share the same communication cable connected to a PC.

Figure 9 shows a PC UART transmitting to a single receiver with a 5kΩ termination resistor while the other receivers remain in a high-impedance state. When the receiver inputs are high impedance, they remain active and maintain receiving capability. This feature permits the design of multidrop applications, which observe the RS-232 interface standard.

Transmitters are enabled and disabled through TXENABLE, allowing the sharing of a single bus line. Transmitters are high impedance when disabled. The host PC's transmitter stays enabled at all times. Only one peripheral transmitter remains enabled at any time. If the host PC wants to communicate with another peripheral, it first must tell the current peripheral to deassert its transmitter.

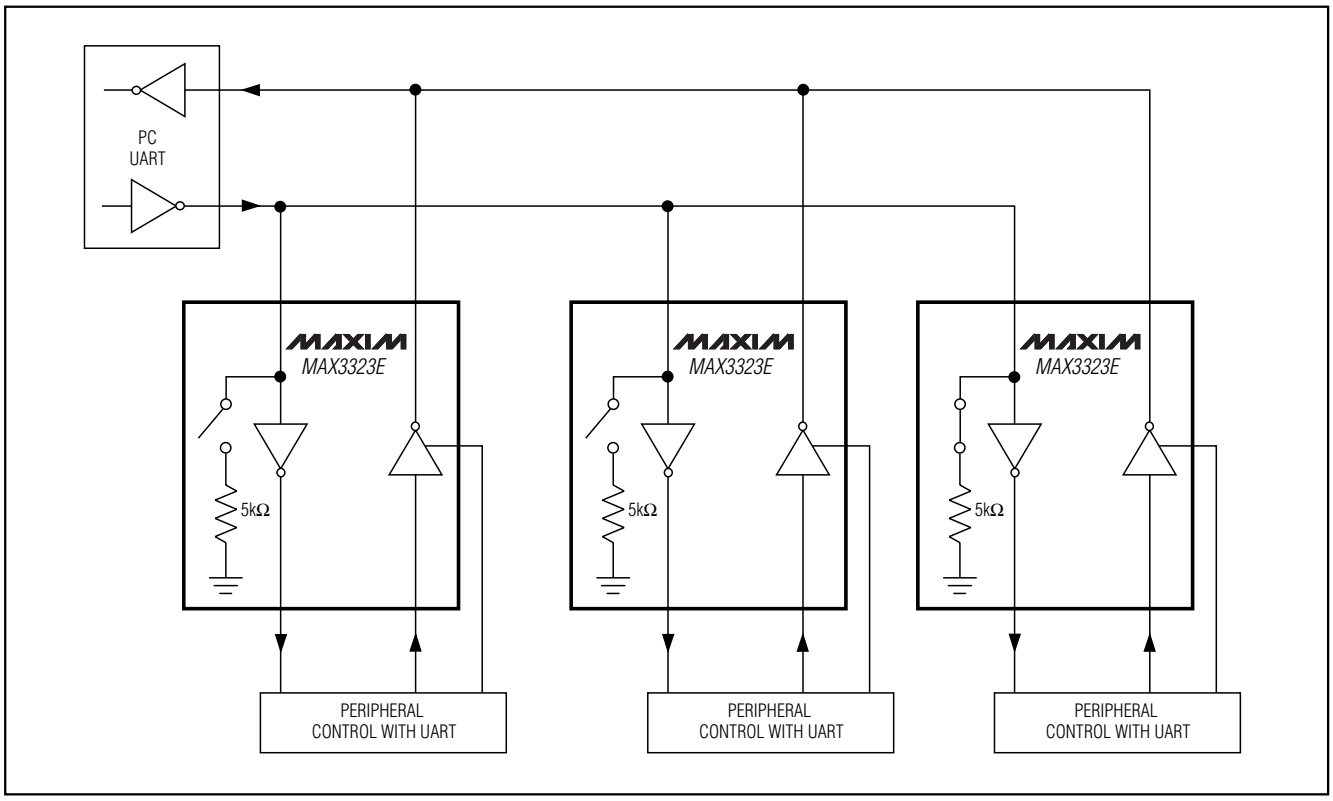


Figure 9. Multidrop Application

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

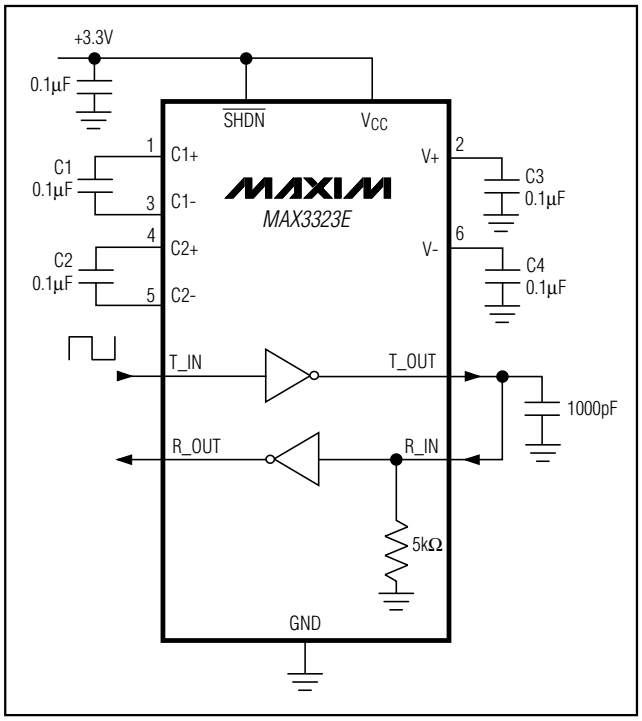


Figure 10. Loopback Test Circuit

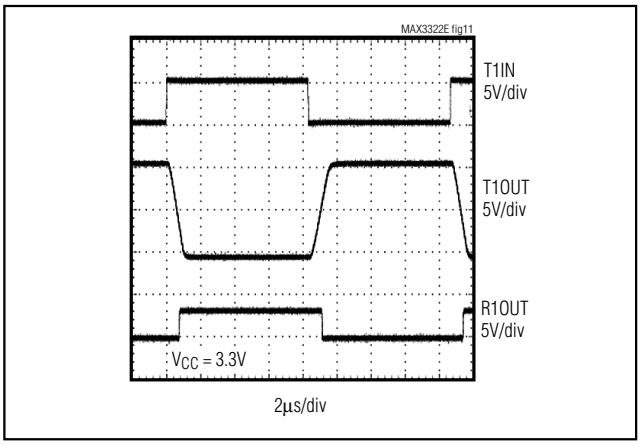


Figure 11. Loopback Test Results at 125kbps

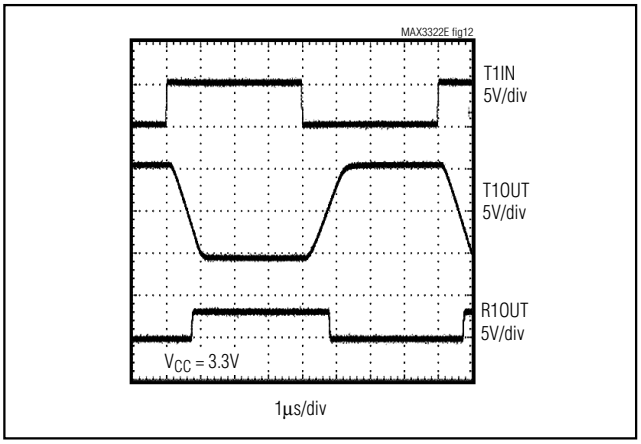


Figure 12. Loopback Test Results at 250kbps

Power-Supply Decoupling

In most circumstances, a 0.1µF bypass capacitor is adequate. In applications sensitive to power-supply noise, decouple V_{CC} to ground with a capacitor of the same value as charge-pump capacitor C1. Connect bypass capacitors as close to the IC as possible.

High Data Rates

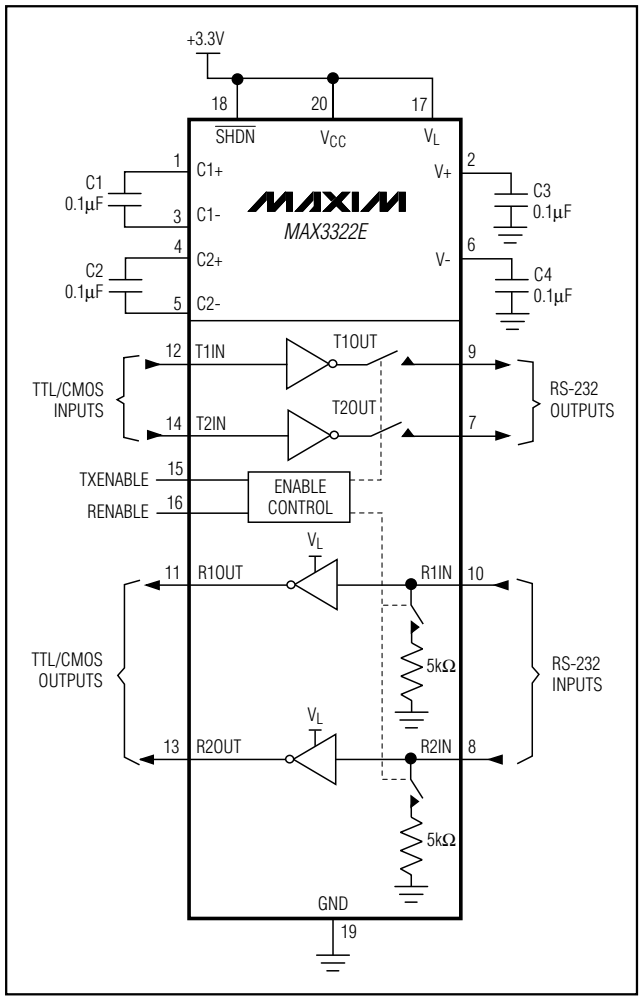
The MAX3322E/MAX3323E maintain the RS-232 ±5.0V minimum transmitter output voltage even at high data rates. Figure 10 shows a transmitter loopback test circuit. Figure 11 shows a loopback test result at 125kbps, and Figure 12 shows the same test at 250kbps. For Figure 11, all transmitters were driven simultaneously at 125kbps into RS-232 loads in parallel with 1000pF. For Figure 12, a single transmitter was driven at 250kbps, and all transmitters were loaded with an RS-232 receiver in parallel with 1000pF.

Interconnection with 3V and 5V Logic

The MAX3322E/MAX3323E can directly interface with various 5V logic families, including ACT and HCT CMOS. The logic voltage power-supply pin V_L sets the output voltage level of the receivers and the input thresholds of the transmitters.

±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

Typical Operating Circuit

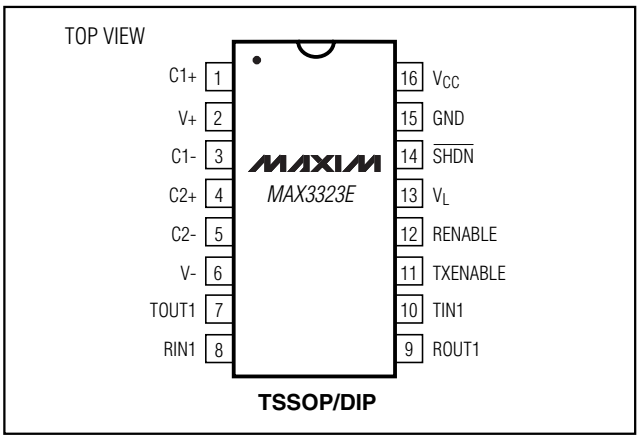


Chip Information

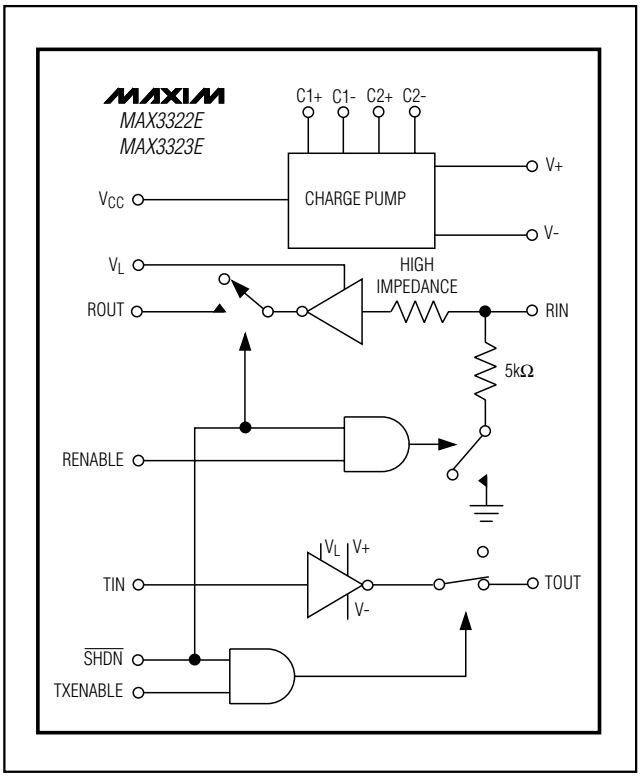
TRANSISTOR COUNT: 1294

PROCESS: BiCMOS

Pin Configurations (continued)



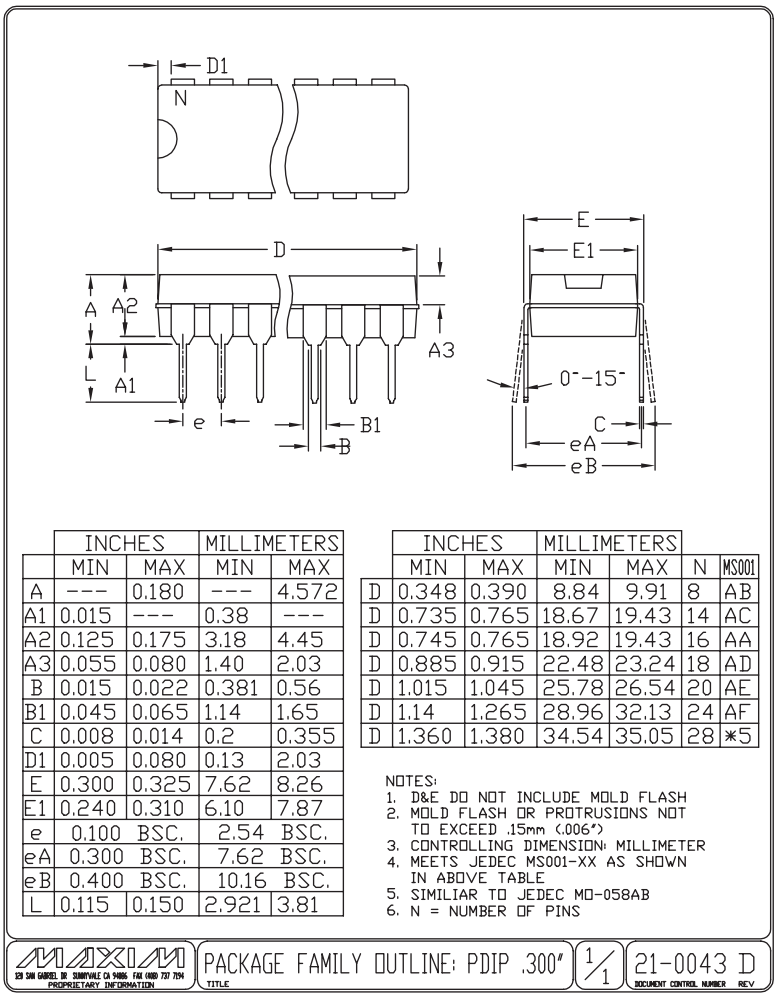
Functional Diagram



±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	---	0.180	---	4.572
A1	0.015	---	0.38	---
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.015	0.022	0.381	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.014	0.2	0.355
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100 BSC.		2.54 BSC.	
eA	0.300 BSC.		7.62 BSC.	
eB	0.400 BSC.		10.16 BSC.	
L	0.115	0.150	2.921	3.81

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS001
D	0.348	0.390	8.84	9.91	8	AB
D	0.735	0.765	18.67	19.43	14	AC
D	0.745	0.765	18.92	19.43	16	AA
D	0.885	0.915	22.48	23.24	18	AD
D	1.015	1.045	25.78	26.54	20	AE
D	1.14	1.265	28.96	32.13	24	AF
D	1.360	1.380	34.54	35.05	28	*5

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILIAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION

TITLE: PACKAGE FAMILY OUTLINE: PDIP .300"

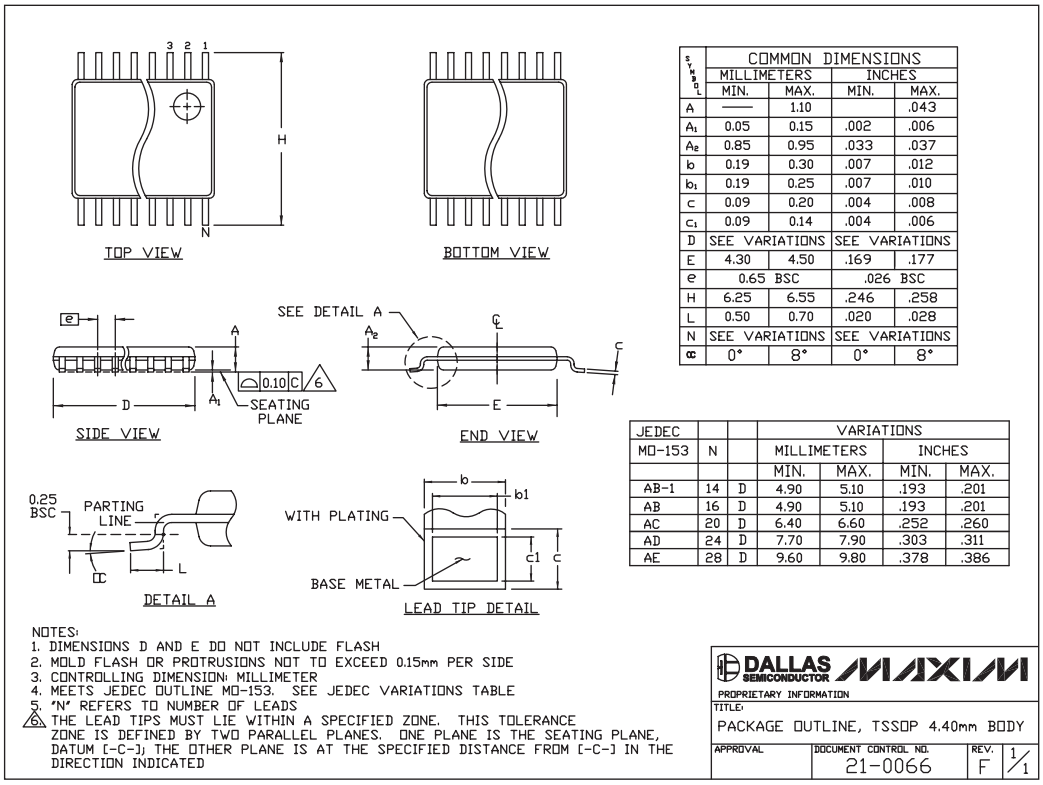
1/1

21-0043 D

DOCUMENT CONTROL NUMBER REV

Package Information (continued)

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)



SYMBOL	COMMON DIMENSIONS			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	——	1.10		.043
A_1	0.05	0.15	.002	.006
A_2	0.85	0.95	.033	.037
b	0.19	0.30	.007	.012
b_1	0.19	0.25	.007	.010
c	0.09	0.20	.004	.008
c_1	0.09	0.14	.004	.006
D	SEE VARIATIONS		SEE VARIATIONS	
E	4.30	4.50	.169	.177
e	0.65 BSC		.026 BSC	
H	6.25	6.55	.246	.258
L	0.50	0.70	.020	.028
N	SEE VARIATIONS		SEE VARIATIONS	
α	0°	8°	0°	8°

JEDEC			VARIATIONS			
MO-153	N		MILLIMETERS		INCHES	
			MIN.	MAX.	MIN.	MAX.
AB-1	14	D	4.90	5.10	.193	.201
AB	16	D	4.90	5.10	.193	.201
AC	20	D	6.40	6.60	.252	.260
AD	24	D	7.70	7.90	.303	.311
AE	28	D	9.60	9.80	.378	.386

NOTES:
1. DIMENSIONS D AND E DO NOT INCLUDE FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm PER SIDE
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC OUTLINE MO-153. SEE JEDEC VARIATIONS TABLE
5. "N" REFERS TO NUMBER OF LEADS
6. THE LEAD TIPS MUST LIE WITHIN A SPECIFIED ZONE. THIS TOLERANCE ZONE IS DEFINED BY TWO PARALLEL PLANES. ONE PLANE IS THE SEATING PLANE, DATUM [-C-], THE OTHER PLANE IS AT THE SPECIFIED DISTANCE FROM [-C-] IN THE DIRECTION INDICATED

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, TSSOP 4.40mm BODY
APPROVAL | DOCUMENT CONTROL NO. 21-0066 | REV. F | 1/1