±15kV ESD-Protected, EMC-Compliant, 230kbps, 3-Tx/3-Rx RS-232 IC

ABSOLUTE MAXIMUM RATINGS

V_{CC} ....-0.3V to +7V
V_{DD} ....-0.3V to +14V
V_{SS} ....+0.3V to -14V
Input Voltages
  T_{IN} ....-0.3V to +6V
  R_{IN} ....±30V
Output Voltages
  T_{OUT} ....±15V
  R_{OUT} ....-0.3V to (V_{CC} + 0.3V)
Short-Circuit Duration
  T_{OUT} (one at a time) ....Continuous
  R_{OUT} (one at a time) ....Continuous

Continuous Power Dissipation (T_A = +70°C)
  DIP (derate 10.53mW/°C above +70°C) 842mW
  Wide SO (derate 20.00mW/°C above +70°C) 1.6W
  SSOP (derate 8.00mW/°C above +70°C) 640mW
Operating Temperature Ranges
  MAX1406C_E ....0°C to +70°C
  MAX1406E_E ....-40°C to +85°C
Storage Temperature Range ....-65°C to +160°C
Lead Temperature (soldering, 10sec) ....+300°C

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.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +4.5V to +5.5V, V_{DD} = +10.8V to +13.2V, V_{SS} = -10.8V to -13.2V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
Operating Voltage Range	V_{CC}		4.5		5.5	V
	V_{DD}		10.8		13.2	
	V_{SS}		-13.2		-10.8	
Supply Current	I_{CC}	No load		230	1000	µA
	I_{DD}			185	500	
	I_{SS}			185	500	
LOGIC						
Input Logic Threshold Low	V_{ILT}	T_IN			0.8	V
Input Logic Threshold High	V_{IHT}	T_IN	2.0			V
Input Leakage Current				0.01	1	µA
Output Voltage Low	V_{OLR}	R_OUT; I_{SINK} = 3.2mA			0.4	V
Output Voltage High	V_{OHR}	R_OUT; I_{SOURCE} = 1mA	V_{CC} - 0.6			V
TRANSMITTER OUTPUTS						
Output Voltage Swing		V_{DD} = 7.0V, V_{SS} = -7.0V, R_L = 3kΩ	±5.0			V
		V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ	±9.5			
Transmitter Output Resistance		V_{CC} = V_{DD} = V_{SS} = 0V, V_{T_OUT} = ±2V	300			Ω
RS-232 Output Short-Circuit Current				±35	±60	mA
RECEIVER INPUTS						
Receiver Input Voltage Operating Range			-25		+25	V
RS-232 Input Threshold Low			0.75			V
RS-232 Input Threshold High					2.4	V
RS-232 Input Hysteresis				0.65		V

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +4.5V to +5.5V, V_{DD} = +10.8V to +13.2V, V_{SS} = -10.8V to -13.2V, T_A = T_{MIN} to $T_{MAX,}$ unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RECEIVER INPUTS (continued)						
RS-232 Input Resistance			3	5	7	kΩ
Receiver Output Short-Circuit Current				±10		mA
ESD CHARACTERISTICS						
ESD Protection		Human Body Model		±15		kV
		IEC1000-4-2 (Contact Discharge)		±8		
		IEC1000-4-2 (Air-Gap Discharge)		±15		

TIMING CHARACTERISTICS

(T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Transmitter Output Propagation Delay, Low to High	t_{PLHT}	V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ, C_L = 1000pF				4	µs
Transmitter Output Propagation Delay, High to Low	t_{PLHT}	V_{DD} = 12V, V_{SS} = -12V R_L = 3kΩ, C_L = 1000pF				4	µs
Transmitter Propagation Delay Skew, $\|t_{PLHT} - t_{PHLT}\|$	t_{SKT}	V_{DD} = 12V, V_{SS} = -12V R_L = 3kΩ, C_L = 1000pF				0.4	µs
Transition Output Slew Rate	SR	V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ to 7kΩ, measured from +3V to -3V or -3V to +3V	C_L = 150pF to 2500pF	4	12	30	V/µs
			C_L = 50pF to 1000pF	8	12	30	
Receiver Output Propagation Delay, Low to High	t_{PLHR}	V_{CC} = 5V, C_L = 50pF				4.0	µs
Receiver Output Propagation Delay, High to Low	t_{PHLR}	V_{CC} = 5V, C_L = 50pF				4.0	µs
Receiver Propagation Delay Skew, $\|t_{PLHR} - t_{PHLR}\|$	t_{SKR}	V_{CC} = 5V, C_L = 50pF				0.4	µs
Guaranteed Data Rate	DR	V_{CC} = 5V, V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ to 7kΩ	C_L = 150pF to 2500pF	120			kbps
			C_L = 50pF to 1000pF	230			

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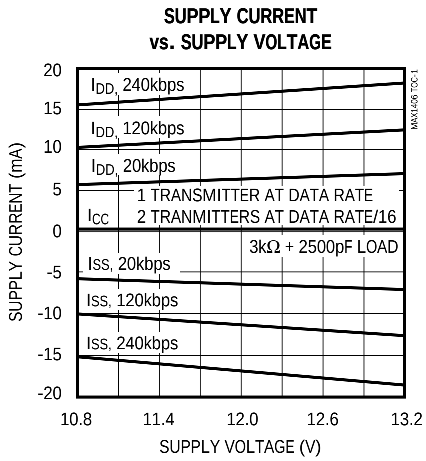
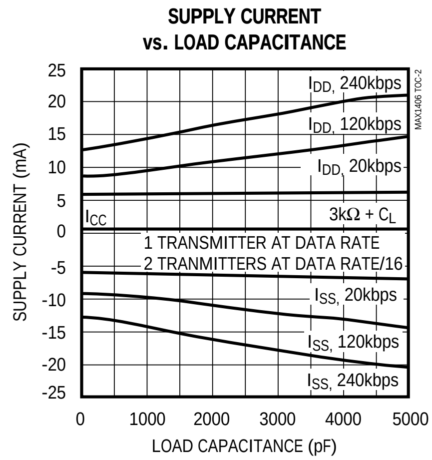
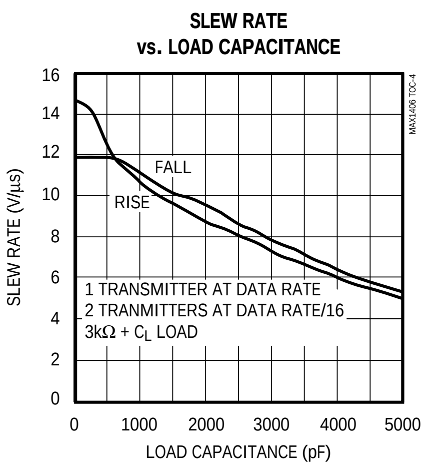
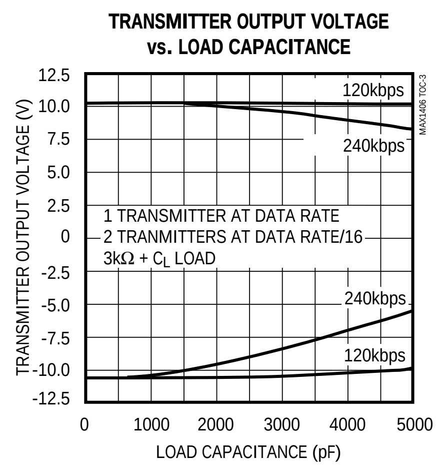
Typical Operating Characteristics

(V_{CC} = +5.0V, V_{DD} = +12.0V, V_{SS} = -12.0V, T_A = +25°C, unless otherwise noted.)









Pin Description

PIN	NAME	FUNCTION
1	V_{DD}	Supply-Voltage Input, +10.8V to +13.2V
3, 5, 7	T1OUT, T2OUT,T3OUT	Transmitter Outputs, swing between V_{DD} and V_{SS}
2, 4, 6	R1IN, R2IN, R3IN	Receiver Inputs
8	V_{SS}	Supply-Voltage Input, -10.8V to -13.2V
9	GND	Ground. Connect to system ground.
10, 12, 14	T3IN, T2IN, T1IN	Transmitter Inputs. Tie unused inputs to GND or V_{CC}.
11, 13, 15	R3OUT, R2OUT, R1OUT	Receiver Outputs, swing between GND and V_{CC}
16	V_{CC}	Supply-Voltage Input, +4.5V to +5.5V

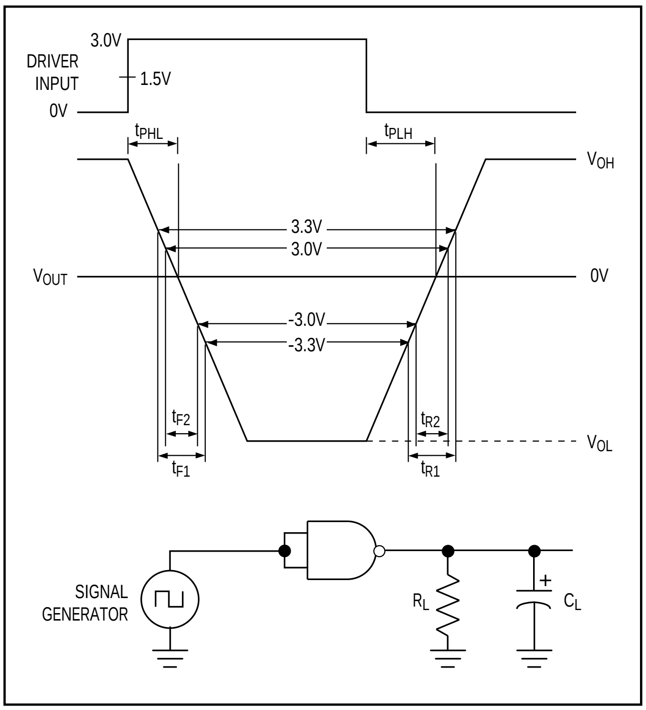


Figure 1. Slew-Rate Test Circuit and Timing Diagram

Detailed Description

RS-232 Transmitters

The transmitters are inverting level translators that convert CMOS-logic input levels to an EIA/TIA-232 voltage between ±5V and ±13.2V, into a load between 3kΩ and 7kΩ. The MAX1406 guarantees a 230kbps data rate with a worst-case load of 3kΩ and 1000pF, providing compatibility with PC-to-PC communication software.

When the power is off, the MAX1406 outputs are permitted to be driven up to ±15V. The transmitter inputs do not have internal pull-up resistors. Connect unused inputs to GND or V_{CC}.

RS-232 Receivers

The receiver inputs invert and convert the RS-232 signals to CMOS-logic output levels. The MAX1406 has hysteresis of 650mV. The receiver output swings between GND and V_{CC}.

±15kV ESD Protection

As with all Maxim devices, electrostatic discharge (ESD) protection structures are incorporated on all pins to protect against ESD encountered during handling and assembly. The MAX1406 driver outputs and receiver inputs have extra protection against static electricity found in normal operation. Maxim's engineers developed state-of-the-art structures to protect these pins against ±15kV ESD without damage. After an ESD event, the MAX1406 continues working without latchup.

ESD protection can be tested in several ways. The transmitter outputs and the receiver inputs are characterized for protection to the following:

1) ±15kV using the Human Body Model
2) ±8kV using the Contact-Discharge method specified in IEC1000-4-2 (formerly IEC801-2)
3) ±15kV using the Air-Gap Discharge method specified in IEC1000-4-2 (formerly IEC801-2)

ESD Test Conditions

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

Human Body Model

Figure 2a shows the Human Body Model, and Figure 2b 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 device through a 1.5kΩ resistor.

IEC1000-4-2

The IEC1000-4-2 standard covers ESD testing and performance of finished equipment; it does not specifically refer to integrated circuits. The MAX1406 helps you design equipment that meets Level 4 (the highest level) of IEC1000-4-2, without additional ESD-protection components.

The main difference between tests done using the Human Body Model and IEC1000-4-2 is higher peak current in IEC1000-4-2 (Figure 3). Because series resistance is lower in the IEC1000-4-2 ESD test model, the ESD withstand voltage measured to this standard is generally lower than that measured using the Human Body Model. Figure 3b shows the current waveform for the ±8kV IEC1000-4-2 Level 4 ESD Contact-Discharge test.

The Air-Gap test involves approaching the device with a charge probe. The Contact-Discharge method connects the probe to the device before the probe is energized.

Machine Model

The Machine Model for ESD testing uses a 200pF storage capacitor and zero-discharge resistance. It mimics the stress caused by handling during manufacturing and assembly. Of course, all pins (not just RS-232 inputs and outputs) require this protection during manufacturing. Therefore, the Machine Model is less relevant to the I/O ports than are the Human Body Model and IEC1000-4-2.

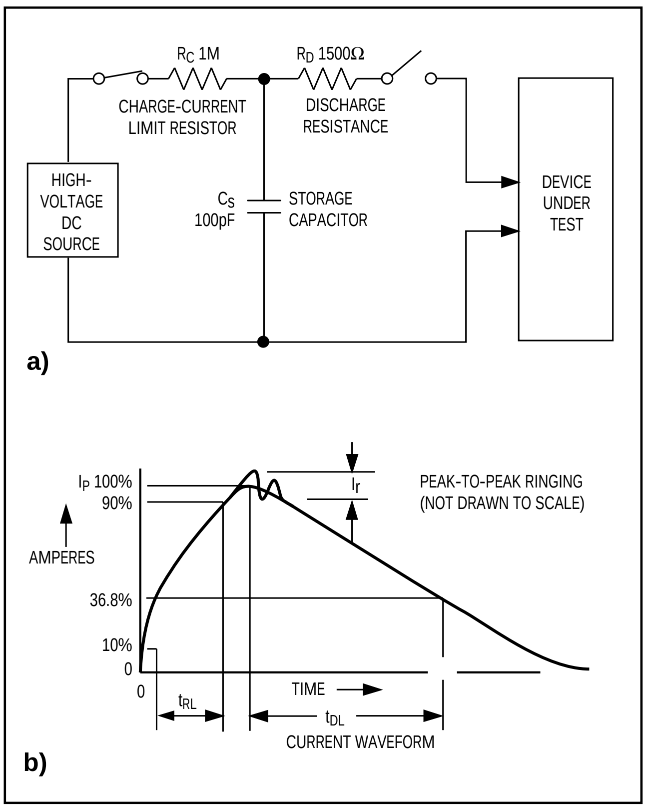


Figure 2. Human Body ESD Test Model and ESD-Generator Current Waveform

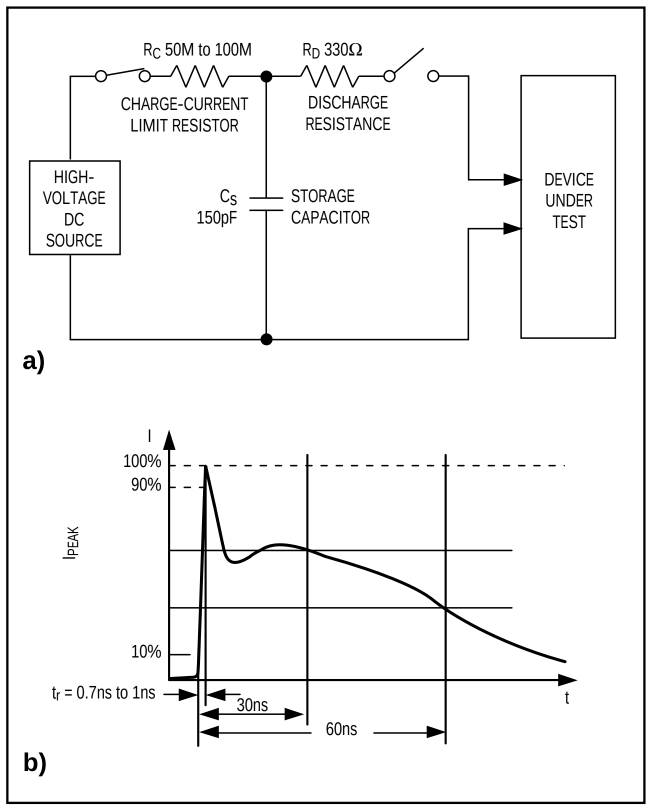


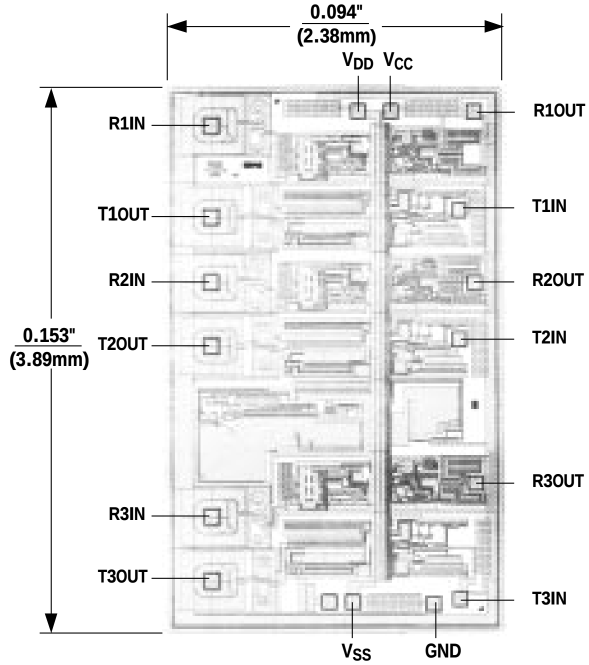
Figure 3. IEC1000-4-2 Test Model and ESD-Generator Current Waveform

Applications Information

Because the MAX1406 is not sensitive to power-supply sequencing, no external protection diodes are required. Any of the three supplies can power up first. However, use proper layout techniques to ensure other devices on your board are not damaged in case of an ESD event.

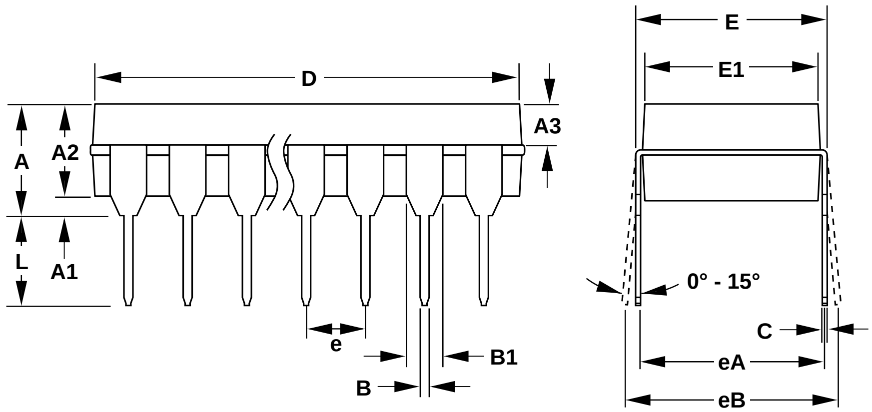
- Minimize the ground-lead return path to the power supply, because currents as high as 60A can pass into the ground.
- Use a separate return path to the power supply.
- Make trace widths greater than 40 mils.
- Bypass V_{CC}, V_{DD}, and V_{SS} with 0.1µF capacitors as close to the MAX1406 as possible to ensure maximum ESD protection.
- Tie any unused transmitter inputs to GND or V_{CC} to minimize power consumption.

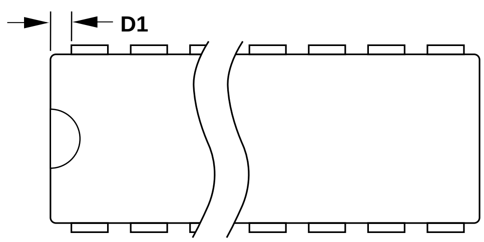
Chip Topography



TRANSISTOR COUNT: 161
SUBSTRATE CONNECTED TO GND

Package Information





DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	–	0.200	–	5.08
A1	0.015	–	0.38	–
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.016	0.022	0.41	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.012	0.20	0.30
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	–	2.54	–
eA	0.300	–	7.62	–
eB	–	0.400	–	10.16
L	0.115	0.150	2.92	3.81

Plastic DIP PLASTIC DUAL-IN-LINE PACKAGE (0.300 in.)

PKG.	DIM	PINS	INCHES		MILLIMETERS	
			MIN	MAX	MIN	MAX
P	D	8	0.348	0.390	8.84	9.91
P	D	14	0.735	0.765	18.67	19.43
P	D	16	0.745	0.765	18.92	19.43
P	D	18	0.885	0.915	22.48	23.24
P	D	20	1.015	1.045	25.78	26.54
N	D	24	1.14	1.265	28.96	32.13

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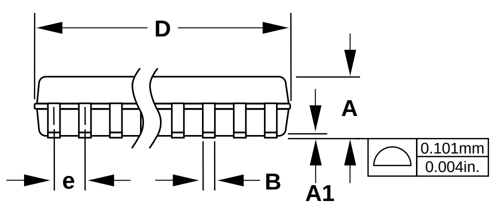
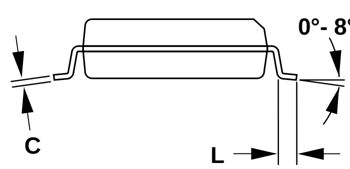
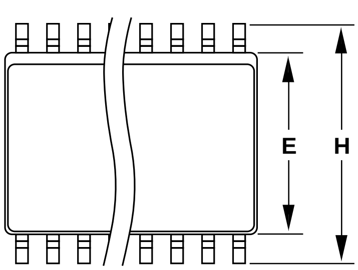




DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.093	0.104	2.35	2.65
A1	0.004	0.012	0.10	0.30
B	0.014	0.019	0.35	0.49
C	0.009	0.013	0.23	0.32
E	0.291	0.299	7.40	7.60
e	0.050		1.27	
H	0.394	0.419	10.00	10.65
L	0.016	0.050	0.40	1.27



Wide SO SMALL-OUTLINE PACKAGE (0.300 in.)

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	16	0.398	0.413	10.10	10.50
D	18	0.447	0.463	11.35	11.75
D	20	0.496	0.512	12.60	13.00
D	24	0.598	0.614	15.20	15.60
D	28	0.697	0.713	17.70	18.10

21-0042A

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