±15kV ESD-Protected, EMC-Compliant, 230kbps RS-232 Serial Port for Modems

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)
  Wide SO (derate 10.00mW/°C above +70°C)..........800mW
  SSOP (derate 8.00mW/°C above +70°C) 640mW
Operating Temperature Ranges
  MAX3186C_P ....0°C to +70°C
  MAX3186E_P ....-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}	No load		280	750	
	I_{SS}	No load		280	750	
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
RS-232 Input Resistance			3	5	7	kΩ
Receiver Output Short-Circuit Current				±10		mA

ELECTRICAL CHARACTERISTICS (continued)

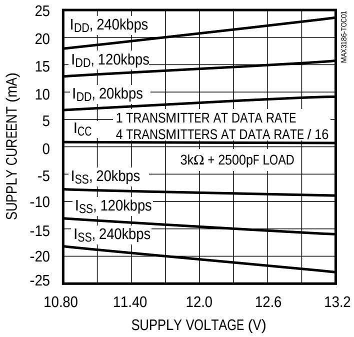
(V_{CC} = +4.5V to +5.5V, V_{DD} = +10.8V to +13.2V, V_{SS} = -10.8V to -13.2V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
ESD CHARACTERISTICS							
ESD Protection		Human Body Model			±15		kV
		IEC1000-4-2 (Contact Discharge)			±8		kV
		IEC1000-4-2 (Air-Gap Discharge)			±15		kV
TIMING CHARACTERISTICS							
Transmitter Output Propagation Delay, Low to High	t_{PLHT}	V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ, C_L = 1000pF, T_A = +25°C				4	µs
Transmitter Output Propagation Delay, High to Low	t_{PHLT}	V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ, C_L = 1000pF, T_A = +25°C				4	µs
Transmitter Propagation Delay Skew, $\lvert t_{PLHT} - t_{PHLT} \rvert$	t_{SKT}	V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ, C_L = 1000pF, T_A = +25°C				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, Figure 3, T_A = +25°C	C_L = 150pF to 2500pF	4		30	V/µs
			C_L = 50pF to 1000pF	8		30	V/µs
Receiver Output Propagation Delay, Low to High	t_{PLHR}	V_{CC} = 5V, C_L = 50pF, T_A = +25°C				4.0	µs
Receiver Output Propagation Delay, High to Low	t_{PHLR}	V_{CC} = 5V, C_L = 50pF, T_A = +25°C				4.0	µs
Receiver Propagation Delay Skew, $\lvert t_{PLHR} - t_{PHLR} \rvert$	t_{SKR}	V_{CC} = 5V, C_L = 50pF, T_A = +25°C				0.4	µs
Guaranteed Data Rate	DR	V_{CC} = 5V, V_{DD} = 12V, V_{SS} = -12V, R_L = 3kΩ to 7kΩ, T_A = +25°C	C_L = 50pF to 2500pF	120			kbps
			C_L = 50pF to 1000pF	230			kbps

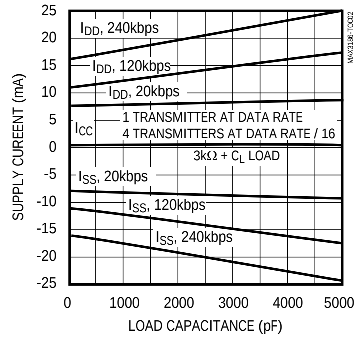
Typical Operating Characteristics

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

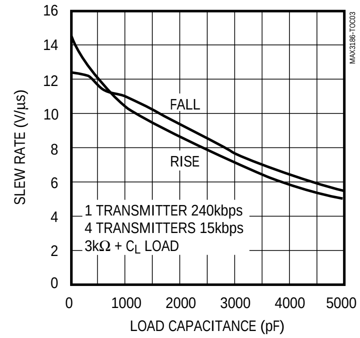
SUPPLY CURRENT vs. SUPPLY VOLTAGE



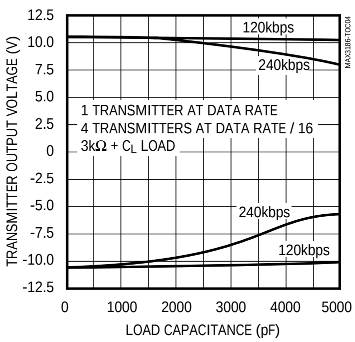
SUPPLY CURRENT vs. LOAD CAPACITANCE



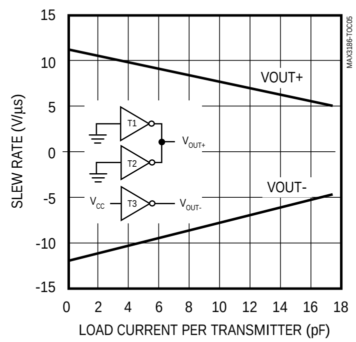
SLEW RATE vs. LOAD CAPACITANCE



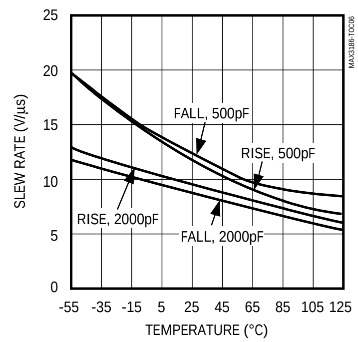
TRANSMITTER OUTPUT VOLTAGE vs. LOAD CAPACITANCE



TRANSMITTER OUTPUT VOLTAGE vs. LOAD CURRENT PER TRANSMITTER



SLEW RATE vs. TEMPERATURE



Pin Description

PIN	NAME	FUNCTION
1	V_{DD}	Supply-Voltage Input, +10.8V to +13.2V
2, 4, 7, 8, 9	T1OUT–T5OUT	Transmitter Outputs, swing between V_{DD} and V_{SS}
3, 5, 6	R1IN, R2IN, R3IN	Receiver Inputs
10	V_{SS}	Supply-Voltage Input, -10.8V to -13.2V
11	GND	Ground. Connect to system ground.
12, 13, 14, 17, 19	T5IN–T1IN	Transmitter Inputs
15, 16, 18	R3OUT, R2OUT, R1OUT	Receiver Outputs, swing between GND and V_{CC}
20	V_{CC}	Supply-Voltage Input, +4.5V to +5.5V

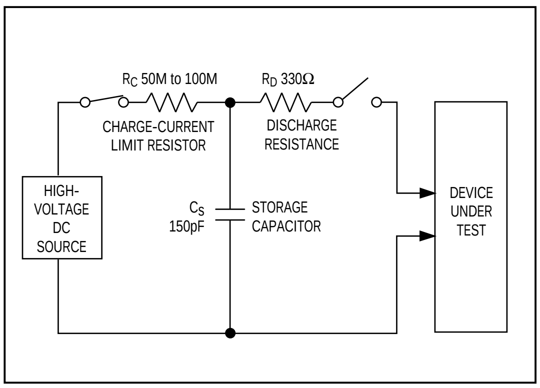


Figure 1a. IEC1000-4-2 ESD Test Model

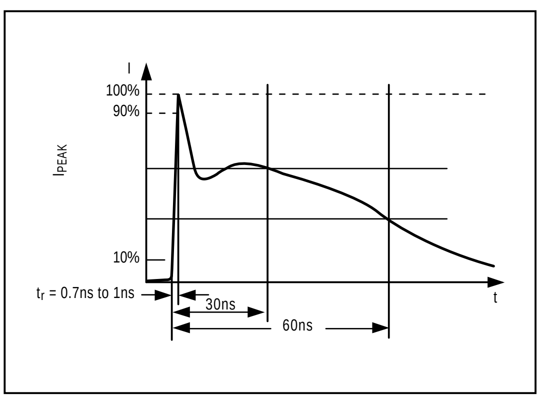


Figure 1b. IEC1000-4-2 ESD Generator Current Waveform

Detailed Description

±15kV ESD Protection

As with all Maxim devices, ESD-protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The MAX3186 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 ESD of ±15kV, without damage. After an ESD event, the MAX3186 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 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.

±15kV ESD-Protected, EMC-Compliant, 230kbps RS-232 Serial Port for Modems

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 MAX3186 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. Because series resistance is lower in the IEC1000-4-2 ESD test model (Figure 1a), the ESD withstand voltage measured to this standard is generally lower than measured using the Human Body Model. Figure 1b 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.

Applications Information

Use proper layout to ensure other devices on your board are not damaged in an ESD strike. Currents as high as 60A can instantaneously pass into the ground, so be sure to minimize the ground-lead return path to the power supply. A separate return path to the power supply is recommend. Trace widths should be greater than 40 mils. Bypass V_{CC}, V_{DD}, and V_{SS} with 0.1µF capacitors as close to the part as possible to ensure maximum ESD protection.

Tie any transmitter inputs to GND or V_{CC}. No external protection diodes are needed because the MAX3186 is not sensitive to power-supply sequencing.

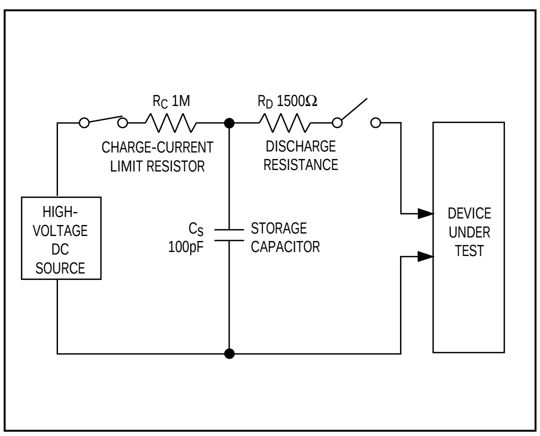


Figure 2a. Human Body ESD Test Model

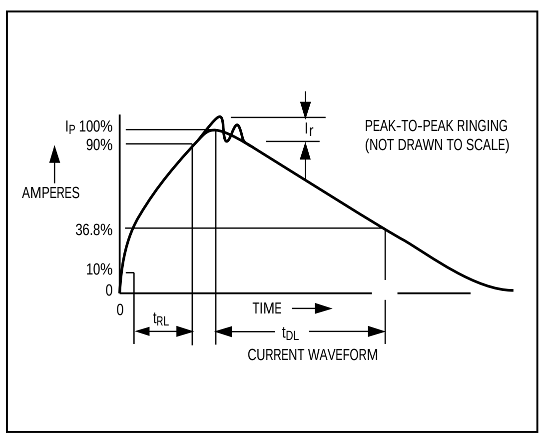


Figure 2b. Human Body Model Current Waveform

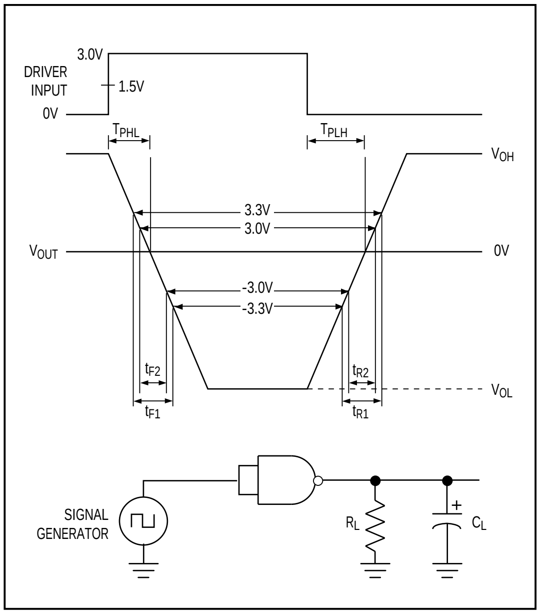
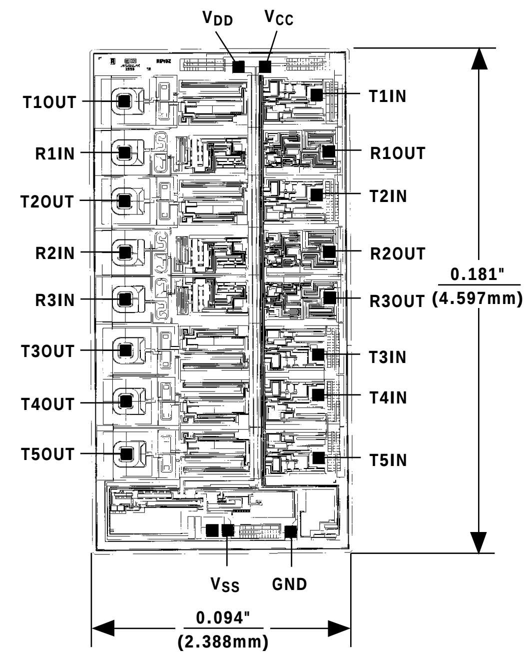


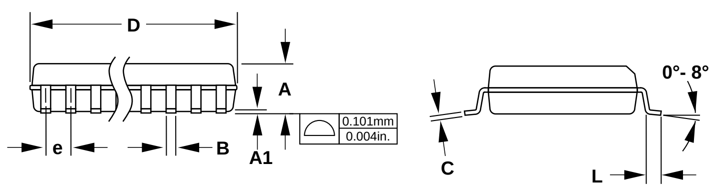
Figure 3. Slew-Rate Test Circuit and Timing Diagram

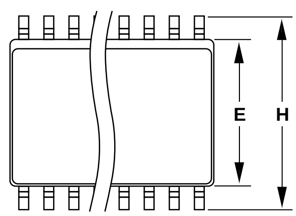
Chip Topography



TRANSISTOR COUNT: 195
SUBSTRATE CONNECTED TO GND

Package Information





Wide SO SMALL-OUTLINE PACKAGE (0.300 in.)

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

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

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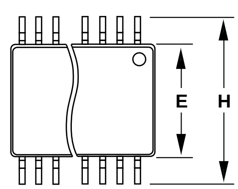

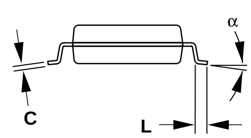

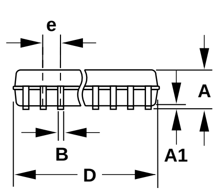

SSOP SHRINK SMALL-OUTLINE PACKAGE

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.068	0.078	1.73	1.99
A1	0.002	0.008	0.05	0.21
B	0.010	0.015	0.25	0.38
C	0.004	0.008	0.09	0.20
D	SEE VARIATIONS			
E	0.205	0.209	5.20	5.38
e	0.0256 BSC		0.65 BSC	
H	0.301	0.311	7.65	7.90
L	0.025	0.037	0.63	0.95
α	0°	8°	0°	8°

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	14	0.239	0.249	6.07	6.33
D	16	0.239	0.249	6.07	6.33
D	20	0.278	0.289	7.07	7.33
D	24	0.317	0.328	8.07	8.33
D	28	0.397	0.407	10.07	10.33

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