19-1931; Rev 1; 3/03

MAXIM

±15kV ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6

General Description

The MAX3190/MAX3190E single RS-232 transmitters in a SOT23-6 package are for space- and cost-constrained applications requiring minimal RS-232 communications. These devices consume only 200µA of supply current from ±7.5V to ±12V supplies. The MAX3190/MAX3190E transmitter outputs are RS-232 compatible when powered from ±6V to ±7.5V supplies. They feature a shutdown input that reduces current consumption to only 1µA and forces the transmitter output into a high-impedance state. RS-232-compliant data transmission is guaranteed up to 460kbps.

The MAX3190/MAX3190E are EIA/TIA-232 transmitters that convert CMOS/TTL logic levels to RS-232-compliant signals. The MAX3190E transmitter output is protected to ±15kV per the Human Body Model, ±8kV per IEC 1000-4-2 Contact Discharge, and ±15kV per IEC 1000-4-2 Air-Gap Discharge, providing protection against harsh environments. The MAX3190/ MAX3190E transmitters have a standard inverting output.

Features

- **Small 6-Pin SOT23 Package**
- **ESD-Protected RS-232 Output (MAX3190E)**
  ±15kV per Human Body Model
  ±8kV per IEC 1000-4-2 Contact Discharge
  ±15kV per IEC 1000-4-2 Air-Gap Discharge
- **200µA Operating Supply Current**
- **Shutdown Reduces Supply Current to 0.4µA**
- **RS-232-Compliant Operation from ±7.5V to ±12V Supplies**
- **RS-232-Compatible Operations from ±6V to ±7.5V Supplies**
- **460kbps Guaranteed Data Rate**
- **Three-State RS-232 Transmitter Output**
- **No External Components**

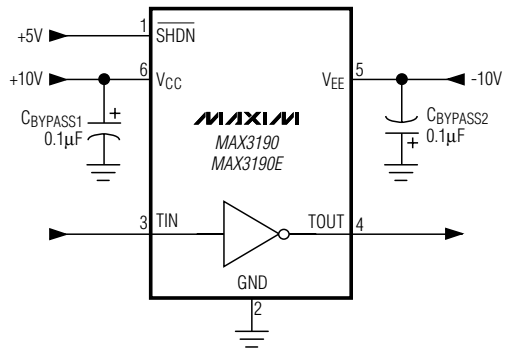
Applications

Set-Top Boxes
Telecommunications
Diagnostic Ports
Networking Equipment
Digital Cameras
Hand-Held Equipment

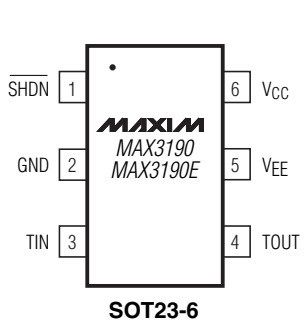
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE	TOP MARK
MAX3190EUT-T	-40°C to +85°C	6 SOT23-6	AAIA
MAX3190EEUT-T	-40°C to +85°C	6 SOT23-6	ABQS

Typical Operating Circuit



Pin Configuration



SOT23-6

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, 460kbps, RS-232 Transmitters in SOT23-6

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND (Note 1) ..... -0.3V to +13.2V
V_{EE} to GND (Note 1) ..... +0.3V to -13.2V
V_{CC} to V_{EE} (Note 1) ..... +22V
TIN, $\overline{SHDN}$ to GND ..... -0.3V to +7V
TOUT to GND ($\overline{SHDN}$ = GND) ..... ±13.2V
Output Short-Circuit to GND Duration ..... Continuous

Continuous Power Dissipation (T_A = +70°C)
6-Pin SOT23 (derate 8.7mW/°C above +70°C) 691mW
Operating Temperature Range ..... -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_{CC} and V_{EE} can have maximum magnitudes of 13.2V, but their absolute difference cannot exceed 22V.

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} = +7.5V to +12V, V_{EE} = -7.5V to -12V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +10V, V_{EE} = -10V, and T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
Positive Supply Voltage	V_{CC}		7.5		12	V
Negative Supply Voltage	V_{EE}		-12		-7.5	V
Positive Supply Current	I_{CC}	$V_{\overline{SHDN}}$ = +5V			250	µA
Negative Supply Current	I_{EE}	$V_{\overline{SHDN}}$ = +5V	-125			µA
Shutdown Supply Current		$V_{\overline{SHDN}}$ = 0		±0.4	±10	µA
INPUT LOGIC (TIN, $\overline{SHDN}$)						
Input Logic Threshold Low	V_{IL}				0.8	V
Input Logic Threshold High	V_{IH}		2.4			V
Input Leakage				±0.01	±1	µA
TIN Input Hysteresis				100		mV
TRANSMITTER OUTPUT						
Output Voltage Swing	V_{TOUT}	V_{CC} = 7.5V, V_{EE} = -7.5V, R_L = 3kΩ	±5			V
		V_{CC} = 6V, V_{EE} = -6V, R_L = 3kΩ	±3.7			V
Output Resistance	R_{TOUT}	V_{CC} = V_{EE} = 0, V_{TOUT} = ±2V	300			Ω
Output Short-Circuit Current				±35	+60	mA
Output Leakage Current	I_{TOUT}	V_{TOUT} = ±12V; V_{CC} = 0 or V_{CC} = +10V, V_{EE} = -10V; $\overline{SHDN}$ = GND			±100	µA
TIMING CHARACTERISTICS						
Maximum Data Rate		R_L = 3kΩ, C_L = 1000pF	460			kbps
Transmitter Skew	t_{TS}	$\lvert t_{PHL} - t_{PLH} \rvert$, Figure 1		100		ns
Transition-Region Slew Rate		R_L = 3kΩ to 7kΩ, C_L = 300pF to 1000pF, measured from -3V to +3V or +3V to -3V, V_{CC} = +10V, V_{EE} = -10V, T_A = +25°C	6		30	V/µs
Transmitter Enable Time	t_{EN}			2		µs

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +7.5V to +12V, V_{EE} = -7.5V to -12V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +10V, V_{EE} = -10V, and T_A = +25°C.) (Note 2)

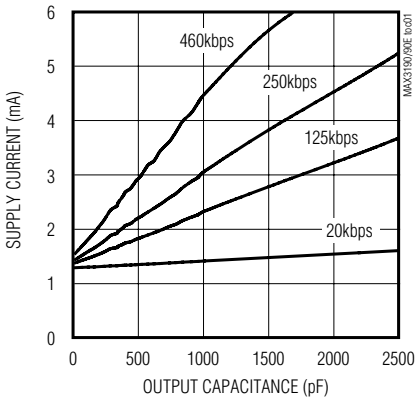
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ESD PROTECTION (MAX3190E)						
TOUT		Human Body Model		±15		kV
		IEC 1000-4-2 Contact Discharge		±8		
		IEC 1000-4-2 Air-Gap Discharge		±15		

Note 2: All devices are 100% tested at T_A = +25°C. All limits over temperature are guaranteed by design.

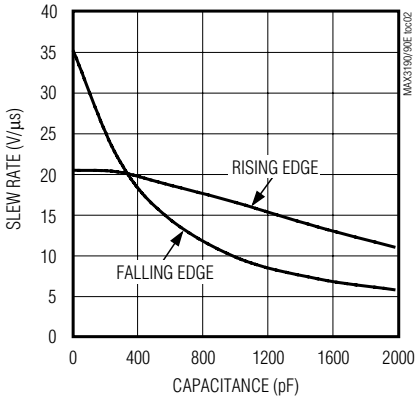
Typical Operating Characteristics

(V_{CC} = +10V, V_{EE} = -10V, R_L = 3kΩ, T_A = +25°C, unless otherwise noted.)

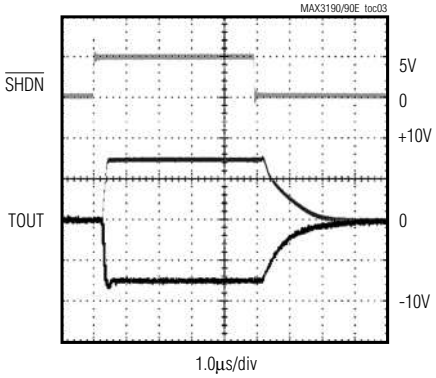
SUPPLY CURRENT vs. OUTPUT CAPACITANCE



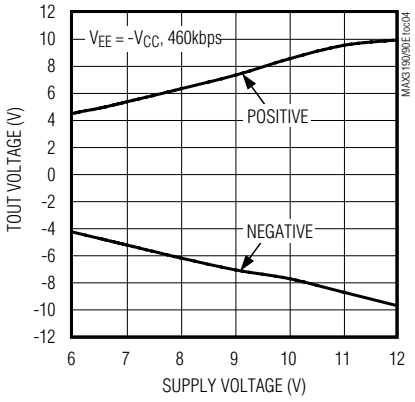
SLEW RATE vs. OUTPUT CAPACITANCE



TRANSMITTER OUTPUT SHUTDOWN WAVEFORM



TRANSMITTER OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



±15kV ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6

Pin Description

PIN	NAME	FUNCTION
1	$\overline{SHDN}$	Active-Low Shutdown. Pull low to reduce the supply current and to force TOUT into a high-impedance state.
2	GND	Ground
3	TIN	TTL/CMOS Transmitter Input
4	TOUT	RS-232 Transmitter Output
5	V_{EE}	Negative Supply Voltage
6	V_{CC}	Positive Supply Voltage

Detailed Description

The MAX3190/MAX3190E are EIA/TIA-232 transmitters that convert CMOS/TTL logic levels to RS-232 signals. They operate on ±7.5V to ±12V supplies and feature enhanced electrostatic discharge protection (see *ESD Protection*). The MAX3190/MAX3190E guarantee a 460kbps data rate with worst-case loads of 3kΩ in parallel with 1000pF. The MAX3190/MAX3190E invert the TOUT signal relative to TIN (standard RS-232). The transmitter input does not have a pullup resistor and should be connected to GND if unused.

Shutdown

The MAX3190/MAX3190E feature a shutdown input. Drive $\overline{SHDN}$ low to reduce the supply current to 1µA (max). Shutdown also forces TOUT into a high-impedance state, allowing the signal line to be safely controlled by other transmitters. Drive $\overline{SHDN}$ high for normal operation.

ESD Protection

As with all Maxim devices, ESD protection structures are incorporated on all pins to protect against ESD encountered during handling and assembly. The MAX3190E's transmitter output has extra protection against static electricity. Maxim has developed state-of-the-art structures enabling this pin to withstand ESD up to ±15kV without damage or latch-up. The MAX3190E's transmitter output is characterized for protection to the following limits:

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

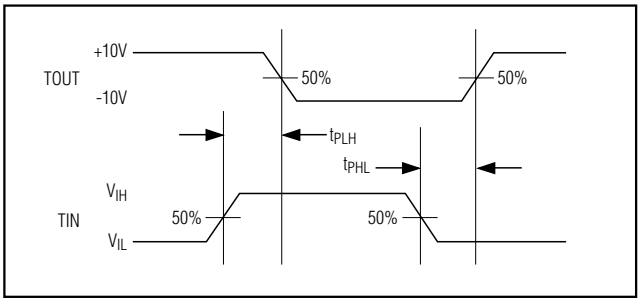


Figure 1. Transmitter Propagation-Delay Timing

Human Body Model

Figure 2 shows the Human Body Model, and Figure 3 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, and then discharged into the test device through a 1.5kΩ resistor.

IEC 1000-4-2

The IEC 1000-4-2 standard covers ESD testing and performance of finished equipment; it does not specifically refer to ICs. The MAX3190E enables the design of equipment that meets the highest level (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 higher peak current in IEC 1000-4-2. Because series resistance is lower in the IEC 1000-4-2 model, the ESD withstand voltage measured to this standard is generally lower than that measured using the Human Body. Figure 4 shows the IEC 1000-4-2 model, and Figure 5

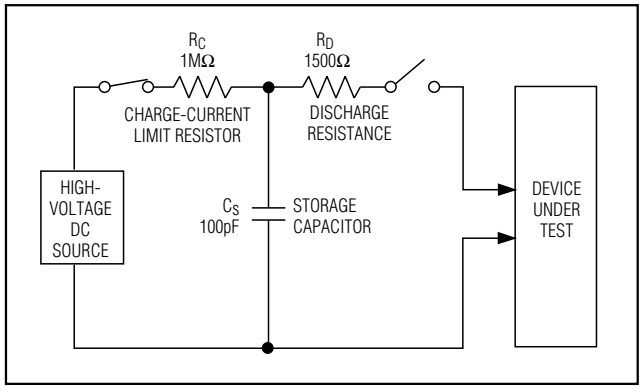


Figure 2. Human Body ESD Test Model

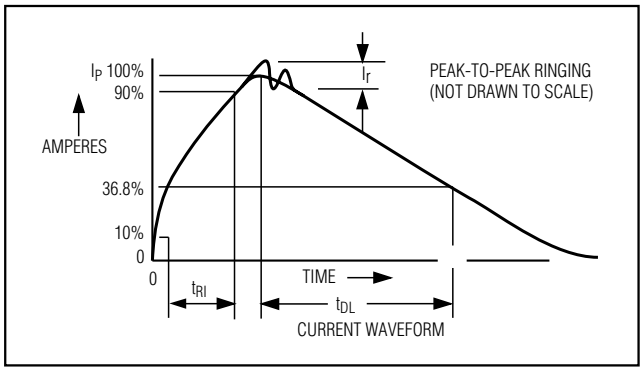


Figure 3. Human Body Model Current Waveform

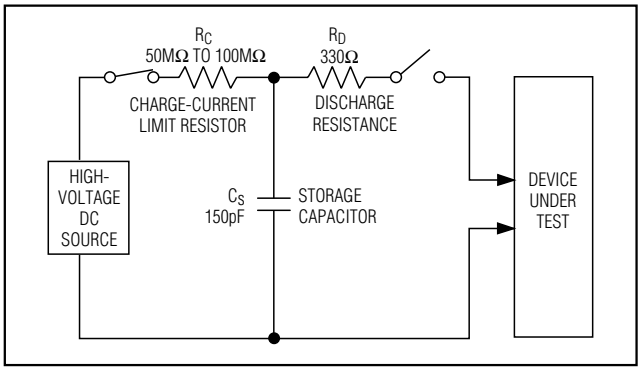


Figure 4. IEC 1000-4-2 ESD Test Model

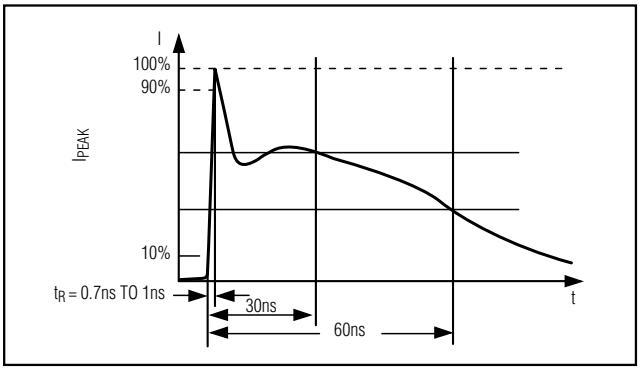


Figure 5. IEC 1000-4-2 Generator Current Waveform

shows the current waveform for the ±8kV IEC 1000-4-2 Level 4 ESD Contact Discharge test. The Air-Gap test involves approaching the device with a charged probe. The Contact Discharge method connects the probe to the device before the probe is energized.

Power-Supply Decoupling

In most circumstances, 0.1µF bypass capacitors are adequate for power-supply decoupling. Connect the bypass capacitors as close to the IC as possible.

Applications Information

Power-Supply Sources

The MAX3190/MAX3190E require ±7.5V to ±12V dual supplies. For applications where these supply voltages are not present, a DC-DC converter must be added. Due to the MAX3190/MAX3190E's low current consumption, a charge pump can provide the proper supply voltages and requires a minimal amount of board space and cost.

When using another RS-232 device containing an internal unregulated charge pump (Tables 1 and 2), the MAX3190/MAX3190E may be powered from the internal charge pump (Figure 6). This eliminates the need for additional external DC-DC converters to generate the required ±7.5V to ±12V dual supplies. The MAX3190/MAX3190E are specifically designed to be used with Maxim's RS-232 products listed in Tables 1 and 2. Competitive RS-232 devices' charge pumps typically do not have the capability to power these devices.

The MAX3190/MAX3190E can be operated from ±6V to ±7.5V supplies. In this condition, the devices are guaranteed to be RS-232-compatible (TOUT ≥ +3.7V).

For applications that have ±4.5V to ±6V supplies available, please refer to the MAX3188/MAX3189 or MAX3188E/MAX3189E data sheet.

±15kV ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6

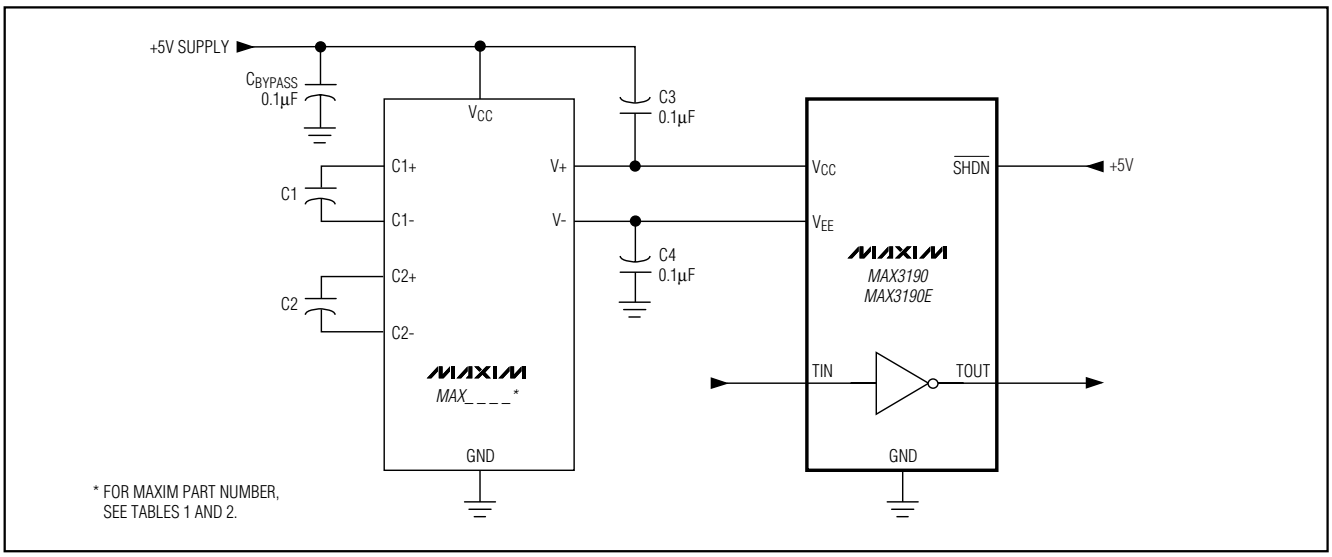


Figure 6. Powering the MAX3190/MAX3190E

Table 1. RS-232 Devices with Internal Unregulated Charge Pumps of ±10V (typical)

PART NUMBER	NO. OF TX/RX	DATA RATE (kbps)
MAX200	5/0	120
MAX201	2/2	120
MAX202	2/2	64
MAX203	2/2	120
MAX204	4/0	120
MAX205	5/5	120
MAX206	4/3	120
MAX207	5/3	120
MAX208	4/4	120
MAX209	3/5	120
MAX211	4/5	120
MAX213	4/5	120
MAX220	2/2	120
MAX221	1/1	250
MAX222	2/2	200
MAX223	4/5	120
MAX225	5/5	120
MAX230	5/0	120
MAX231	2/2	120
MAX232	2/2	120
MAX232A	2/2	200
MAX233A	2/2	200
MAX233	2/2	120
MAX234	4/0	120
MAX235	5/5	120
MAX236	4/3	120
MAX237	5/3	120
MAX238	4/4	120
MAX239	3/5	120
MAX240	5/5	120
MAX241	4/5	120
MAX242	2/2	200
MAX243	2/2	200
MAX244	8/10	120
MAX248	8/8	120
MAX249	6/10	120

Table 2. ±15kV ESD-Protected RS-232 Devices with Internal Unregulated Charge Pumps of ±10V (typical)

PART NUMBER	NO. OF TX/RX	DATA RATE (kbps)
MAX202E	2/2	64
MAX203E	2/2	120
MAX205E	5/5	120
MAX206E	4/3	120
MAX207E	5/3	120
MAX208E	4/4	120
MAX211E	4/5	120
MAX213E	4/5	120
MAX221E	1/1	250
MAX241E	4/5	120

Chip Information

TRANSISTOR COUNT: 75

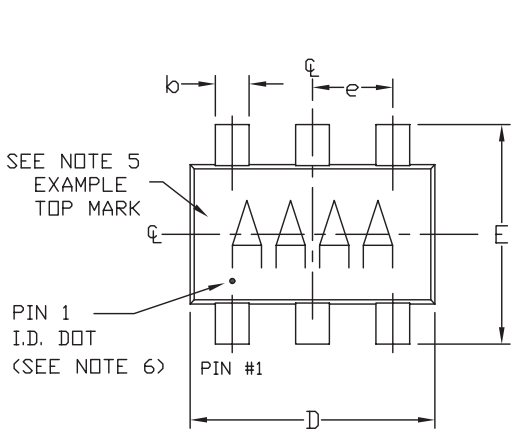
PROCESS: CMOS

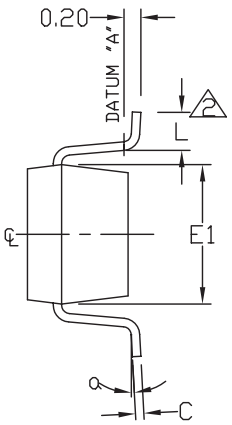
±15kV ESD-Protected, 460kbps, RS-232 Transmitters in SOT23-6

Package Information

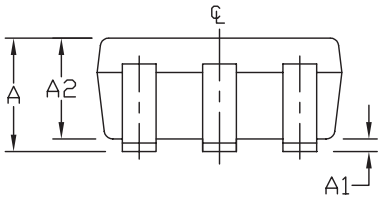
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)

6LSOT.EPS





SYMBOL	MIN	MAX
A	0.90	1.45
A1	0.00	0.15
A2	0.90	1.30
b	0.35	0.50
C	0.08	0.20
D	2.80	3.00
E	2.60	3.00
E1	1.50	1.75
L	0.35	0.55
e	0.95 REF	
α	0°	10°



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. FOOT LENGTH MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR.
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. PIN 1 IS LOWER LEFT PIN WHEN READING TOP MARK FROM LEFT TO RIGHT. (SEE EXAMPLE TOP MARK)
6. PIN 1 I.D. DOT IS 0.3 MM ø MIN. LOCATED ABOVE PIN 1.
7. MEETS JEDEC MO178.

MAXIM
PROPRIETARY INFORMATION

TITLE: PACKAGE OUTLINE, SOT-23, 6L

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0058	E	1/1

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