Low-Profile, 3V, 120µA, IrDA Infrared Transceiver

ABSOLUTE MAXIMUM RATINGS

(Referred to GND)
V_{CC} ....-0.3V to +6V
TXD, $\overline{SHDN}$, LEDC ....-0.3V to +6V
RXD ....-0.3V to (V_{CC} + 0.3V)
PGND ....-0.1V to +0.1V
PINC 10mA
Continuous LEDC Current..200mA
Repetitive Pulsed LEDC Current
(<90µs, duty cycle <20%) 500mA

Continuous Power Dissipation (T_A = +70°C)
µMAX (derate 4.1mW/°C above +70°C) 330mW
SO (derate 5.88mW/°C above +70°C).......................471mW
Operating Temperature Ranges
MAX3120C_A..0°C to +70°C
MAX3120E_A..-40°C to +85°C
Junction Temperature ....+150°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} = +3.0V to +5.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = +3.3V.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
Supply Current	I_{CC}	T_A = +25°C, $\overline{SHDN}$ = V_{CC} (Note 1)		120	200	µA
Shutdown Supply Current	$I_{CC(SHDN)}$	T_A = +25°C, $\overline{SHDN}$ = GND (Note 1)		0.01	1.0	µA
LOGIC INPUTS (TXD, $\overline{SHDN}$)						
Input Logic Threshold Low	V_{IL}				0.8	V
Input Logic Threshold High	V_{IH}	V_{CC} = 3.3V	2.0			V
		V_{CC} = 5.0V	2.4			
Input Leakage Current	I_{LEAK}		-1		1	µA
Input Capacitance	C_{IN}			2		pF
LOGIC OUTPUT (RXD)						
Output Voltage	V_{OL}	I_{SINK} = 200µA		0.1	0.4	V
	V_{OH}	I_{SOURCE} = 100µA	V_{CC} - 0.5	V_{CC} - 0.05		
Output Rise and Fall Time	t_r, t_f	C_{LOAD} = 50pF		50		ns
IR RECEIVER						
Supported Data Rates			2.4		115.2	kbps
Equivalent Input Noise Current	I_{NOISE}	(Note 2)		10		nA_{RMS}
Input Current Sensitivity		(Note 3)	0.0002		6	mA
Ambient DC Current Rejection		V_{CC} = 3.3V		100		µA
		V_{CC} = 5.0V		375		
Shutdown Time		Delay until I_{CC} < 1µA		10		µs
Shutdown Disable Time		Delay until maximum IR receiver data rate is valid		300		µs
IR Receiver Output Pulse Width		Data rate = 2.4kbps	1		90	µs
		Data rate = 115.2kbps	1		8	

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +3.0V to +5.5V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = +3.3V.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
IR TRANSMITTER							
Transmitter Rise Time	t_r	10% to 90% of 200mA drive current			20	600	ns
Transmitter Fall Time	t_f	90% to 10% of 200mA drive current			20	600	ns
Transmitter Output Resistance		I_{OUT} = 200mA	V_{CC} = 3.3V		1.15	2.0	Ω
			V_{CC} = 5.0V		0.9	1.6	
Off-Leakage Current					0.01	10	µA

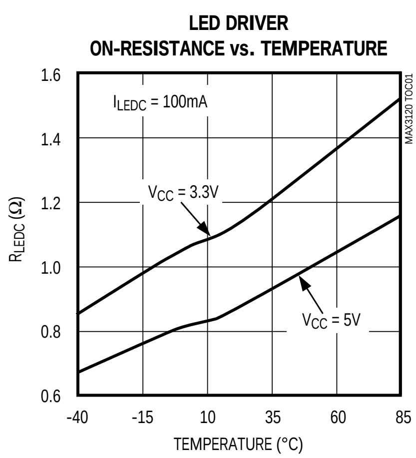
Note 1: All supply current measurements are made under the following conditions: no load at all outputs, input voltages at GND or V_{CC}, no PIN diode input current.

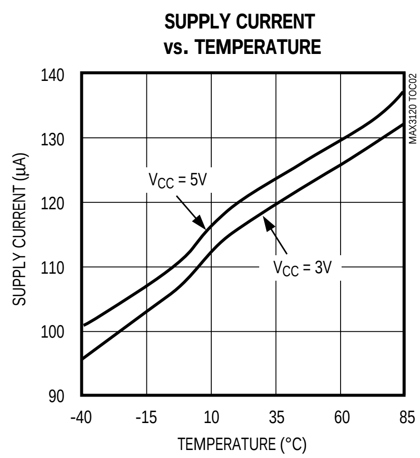
Note 2: Equivalent input current noise is calculated by dividing the output noise of the transimpedance amplifier by the midband transimpedance gain.

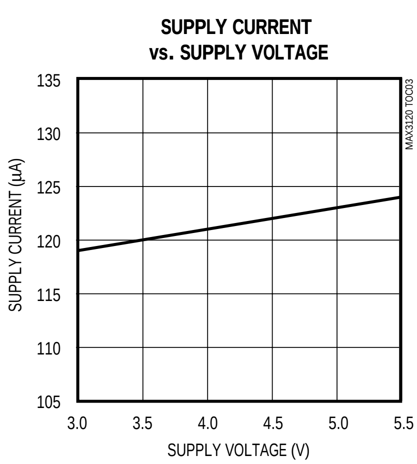
Note 3: Sensitivity is measured with an IrDA-compliant input signal, where the data rate is within the Supported Data Rate, rise/fall times are less than 600ns, and pulse widths are between 1.41µs and 3/16 of the baud rate.

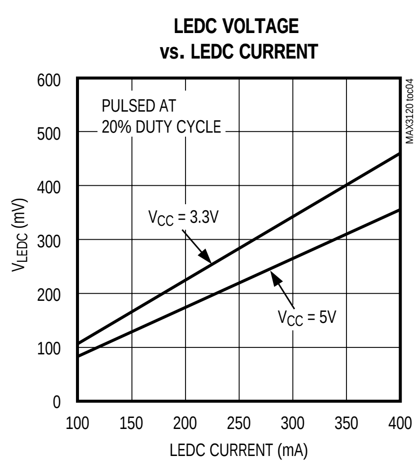
Typical Operating Characteristics

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







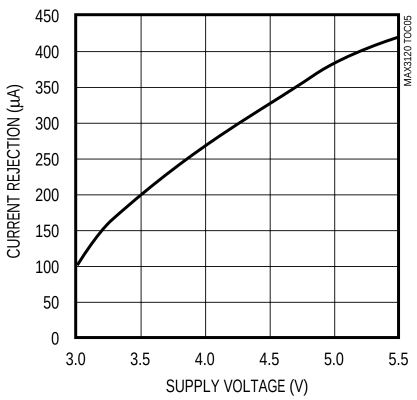


Low-Profile, 3V, 120µA, IrDA Infrared Transceiver

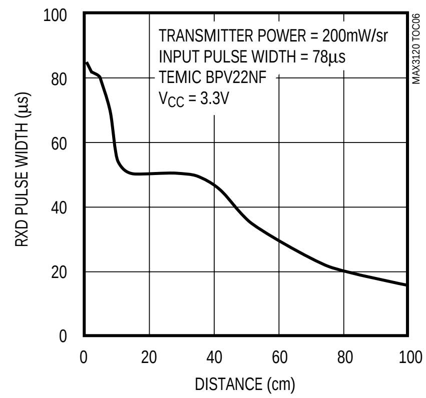
Typical Operating Characteristics (continued)

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

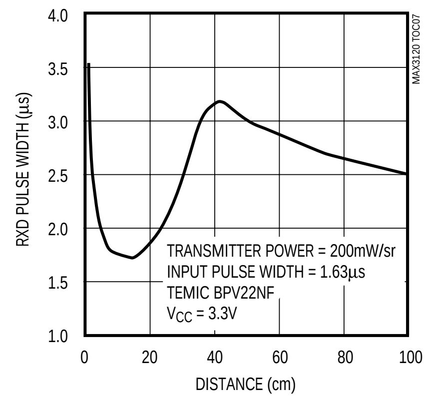
AMBIENT PHOTODIODE CURRENT REJECTION vs. SUPPLY VOLTAGE



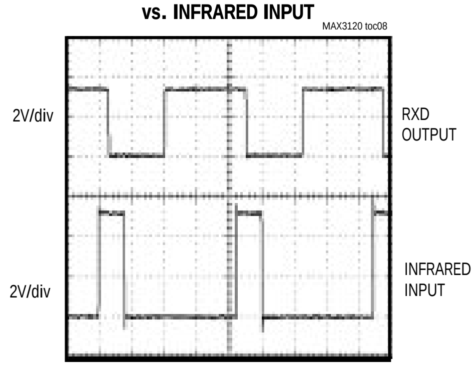
RXD OUTPUT PULSE WIDTH vs. DISTANCE



RXD OUTPUT PULSE WIDTH vs. DISTANCE



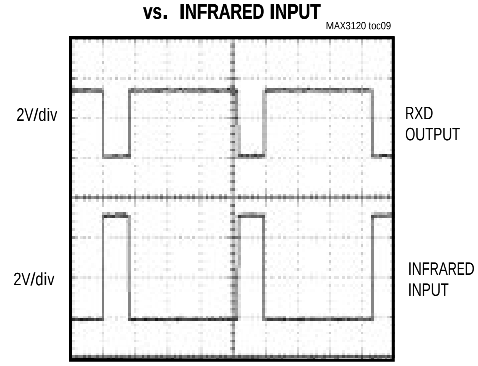
RXD OUTPUT vs. INFRARED INPUT



2µs/div

V_{CC} = 3.3V, 115.2kbps AT 1cm DISTANCE,
TERMIC BPV22NF, TRANSMIT POWER 200mW/sr

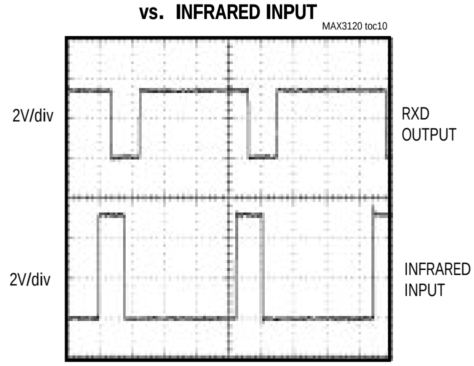
RXD OUTPUT vs. INFRARED INPUT



100µs/div

V_{CC} = 3.3V, 2400bps AT 1cm DISTANCE,
TERMIC BPV22NF, TRANSMIT POWER 200mW/sr

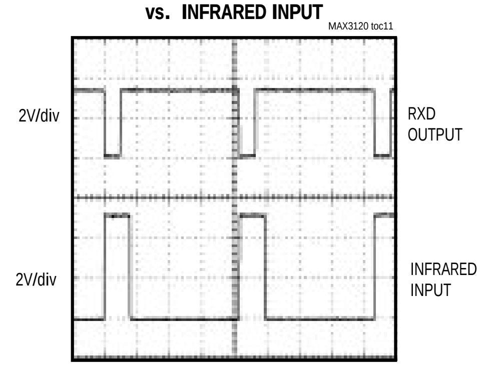
RXD OUTPUT vs. INFRARED INPUT



2µs/div

V_{CC} = 3.3V, 115.2kbps AT 10cm DISTANCE,
TERMIC BPV22NF, TRANSMIT POWER 200mW/sr

RXD OUTPUT vs. INFRARED INPUT

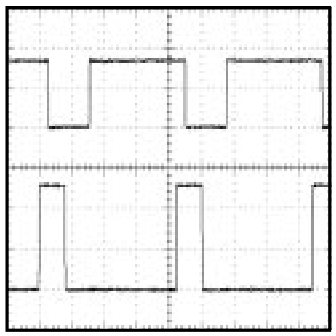


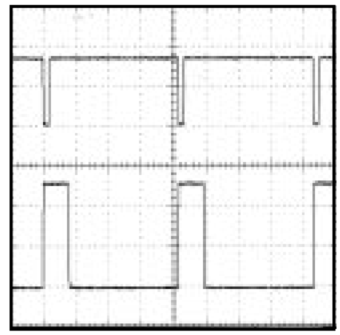
100µs/div

V_{CC} = 3.3V, 2400bps AT 10cm DISTANCE,
TERMIC BPV22NF, TRANSMIT POWER 200mW/sr

Typical Operating Characteristics (continued)

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





Pin Description

PIN	NAME	FUNCTION
1	TXD	IR Transmitter TTL/CMOS Data Input. High = LED on.
2	V_{CC}	Supply Voltage
3	GND	Ground. Connect anode of PIN diode to GND. Connect GND to PGND.
4	PINC	PIN Diode Cathode Input. Connect cathode of PIN diode to PINC.
5	$\overline{SHDN}$	Shutdown Input. Active low.
6	PGND	Power Ground. Ground for IR LED driver. Connect PGND to GND.
7	LEDC	LED Driver Output. Connect cathode of IR-emitting LED to LEDC.
8	RXD	IR Receiver TTL/CMOS Data Output. Pulses low for IR input pulse.

Detailed Description

The MAX3120 is an IrDA 1.2-compatible infrared (IR) transceiver. By selecting appropriate external optical components (see *IR LED and PIN Photodiode Selection* section), the MAX3120 will operate at data rates of 2.4kbps to 115kbps at distances from 1cm to 1m. Because of its low-noise design, the MAX3120 achieves a bit error rate (BER) below 10^{-8} at maximum data rates when used with the appropriate external components. On-chip filtering rejects out-of-band ambient light signals that would otherwise interfere with IR communication. Also included in the MAX3120 is a high-power LED driver capable of sinking 200mA. It can drive most available IR LEDs at IrDA speeds of 2.4kbps to 115kbps.

Receiver

The MAX3120's IR receiver amplifier reverse biases the PIN diode by approximately 1.2V, and the PIN diode converts pulses of IR light into pulses of current. The input transimpedance (current-to-voltage) amplifier then converts these current pulses into voltage pulses of a useful magnitude. The MAX3120 filters the resulting output voltage pulses to remove low-frequency ambient light interference and high-frequency circuit noise. Finally, a high-speed comparator translates these voltage pulses into usable CMOS output levels (Figure 1).

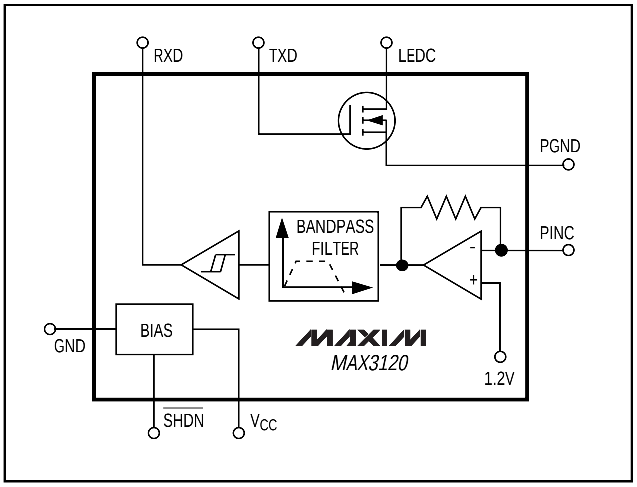


Figure 1. Functional Diagram

Transmitter

The MAX3120's IR transmitter consists of a high-power MOS switch, capable of quickly switching 200mA with less than 2Ω of on-resistance. Internal buffering keeps the input capacitance of the TXD pin extremely low to ease the input drive requirement. Connect an IR LED in series with a current-setting resistor to select the appropriate IR output power (see the *Powering the IR LED* section). Note that the transmitter does not have an automatic shutoff circuit, so pay special attention to component power dissipation in high-duty-cycle transmit schemes.

Applications Information

IR LED and PIN Photodiode Selection

The IrDA specification calls for an IR transmitter with a peak wavelength between 850nm and 900nm. Within a ±15° half-cone-angle, the output intensity of the IR LED must be between 40mW/sr and 500mW/sr. Outside a ±30° half-cone-angle, the output intensity of the IR LED must fall below 40mW/sr. The optical rise and fall times of the IR LED must be less than 600ns. Based on these system requirements, the Hewlett Packard HSDL-4220 or the Temic TSHF5400 IR LEDs are two appropriate choices.

Appropriate PIN photodiode selection is extremely important to system performance. The PIN diode must generate at least 200nA (minimum sensitivity of the MAX3120) of current when aimed ±15° off-axis with an incident irradiance of 4µW/cm². Use the following equation to determine if the Temic BPV22NF meets these requirements:

$$I_{PIN} = (4\mu W/cm^2)(0.075cm^2)(1.8)(0.95)^2(0.6A/W)$$
$$= 291nA$$

The first term (4µW/cm²) is the minimum guaranteed irradiance in the ±15° angular range. The second term (0.075cm²) is the effective sensitive area of the PIN diode. The factor of 1.8 accounts for the efficiency increase due to the spherical lens. The first 0.95 factor normalizes the sensitivity to the 875nm wavelength, while the second 0.95 factor adjusts for decreased receiver efficiency at ±15° off-axis. The last term, 0.6A/W, is the sensitivity of the PIN diode. In this example, the Temic BPV22NF is an appropriate selection.

The final important factor in selecting a PIN diode is effective diode capacitance. It is important to keep this capacitance below 70pF at 1.2V reverse bias. Higher input capacitance can compromise system noise performance by increasing the noise gain of the input transimpedance amplifier.

Powering the IR LED

Set the current in the IR LED using an external resistor. Consult the IR LED manufacturer's data sheet to select a forward current that will meet IrDA specifications discussed in the *IR LED and PIN Photodiode Selection* section. Look up the drop across the LED (V_{LED}) and the drop across the MAX3120 LED driver (see *Typical Operating Characteristics* - V_{LEDC}) and choose the current-setting resistor based on the following equation:

$$R_{SET} = \frac{V_{CC} - V_{LED} - V_{LEDC}}{I_{SET}}$$

Using the Hewlett Packard HSDL-4220 IR LED as an example, V_{CC} = 5V, I_{SET} = 100mA, and V_{LED} = 1.67V, therefore:

$$V_{LEDC} = 0.08V$$
$$R_{SET} = 32.5\Omega$$

Power-dissipation requirements of the MAX3120, IR LED, and R_{SET} must be met based on maximum duty cycle and output current requirements.

MAX3120 Power Dissipation = $I_{SET} \cdot V_{LEDC} \cdot$ Duty Cycle

IR LED Power Dissipation = $I_{SET} \cdot V_{LED} \cdot$ Duty Cycle

R_{SET} Power Dissipation = $I_{SET}^2 \cdot R_{SET} \cdot$ Duty Cycle

Power-Supply Noise Rejection

Because of the extremely sensitive nature of photodiode amplifiers, it is important to maintain a quiet supply voltage. Use a separate analog supply voltage where possible. Place a 1µF ceramic bypass capacitor as close to the V_{CC} pin as possible. In especially noisy systems, connect a small (10Ω) resistor in series with V_{CC}, in addition to the normal bypass capacitor.

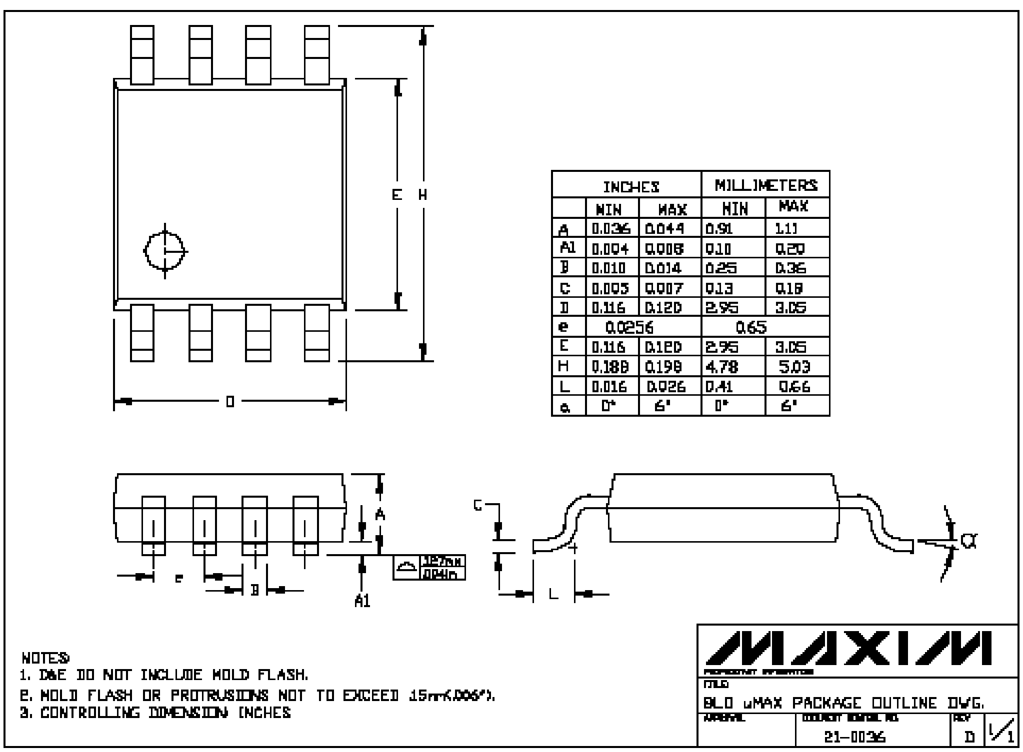
Layout Considerations

The MAX3120 requires careful layout techniques to minimize parasitic signal coupling to the PINC input. Keep the lead length between the photodiode and PINC as short as possible. Be sure to keep PC board traces to the PIN diode separate from other noisy traces. To minimize coupling, run the AGND trace adjacent to the PINC trace on both sides. To prevent oscillation, avoid routing the RXD signal near the PINC signal. Connect the anode of the PIN diode, the GND pin, and the supply bypass capacitor pin in a star-ground connection. Connect PGND and GND together. Reduce the output trace length from RXD as much as possible to minimize coupling back to the input via parasitic capacitance.

Chip Information

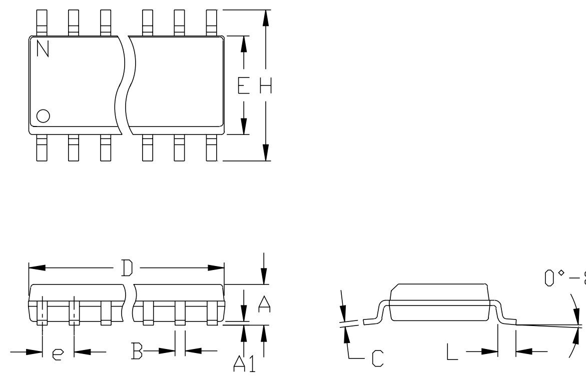
TRANSISTOR COUNT: 256

Package Information



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.036	0.044	0.91	1.11
A1	0.004	0.008	0.10	0.20
B	0.010	0.014	0.25	0.36
C	0.005	0.007	0.13	0.18
D	0.116	0.120	2.95	3.05
e	0.0256		0.65	
E	0.116	0.120	2.95	3.05
H	0.188	0.198	4.78	5.03
L	0.016	0.026	0.41	0.66
α	0°	6°	0°	6°

Package Information (continued)



	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050		1.27	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
h	0.010	0.020	0.25	0.50
L	0.016	0.050	0.40	1.27

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS012
D	0.189	0.197	4.80	5.00	8	A
D	0.337	0.344	8.55	8.75	14	B
D	0.386	0.394	9.80	10.00	16	C

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. LEADS TO BE COPLANAR WITHIN .102mm (.004")
4. CONTROLLING DIMENSION: MILLIMETER
5. MEETS JEDEC MS012-XX AS SHOWN IN ABOVE TABLE
6. N = NUMBER OF PINS

MAXIM 120 SAN GABRIEL DR. SUNNYVALE CA 94086 FAX (408) 737 7194 PROPRIETARY INFORMATION | TITLE: PACKAGE FAMILY OUTLINE: SOIC .150" | 1/1 | DOCUMENT CONTROL NUMBER 21-0041 REV A