19-1076; Rev 0; 9/96

MAXIM

# ±15kV ESD-Protected, EMC-Compliant, 230kbps RS-232 Serial Port for Motherboards/Desktop PCs



## General Description

The MAX3185 is a complete DTE RS-232 serial port designed to meet the stringent ESD requirements of the European community. All transmitter outputs and receiver inputs are protected to ±15kV using IEC 1000-4-2 Air-Gap Discharge, ±8kV using IEC 1000-4-2 Contact Discharge, and ±15kV using the Human Body Model.

The MAX3185 has three RS-232 transmitters, five RS-232 receivers, and no charge pump, optimizing it for operation in desktop PC and motherboard applications. It is guaranteed to run at data rates up to 230kbps, providing compatibility with popular software for communicating with personal computers. Power-supply current is less than 300µA for $I_{DD}$ and $I_{SS}$, and less than 1mA for $I_{CC}$.

The MAX3185 is pin and functionally compatible with the industry-standard 75185, so existing designs can instantly become EMC compliant. The MAX3185 is available in an SO package and in the tiny SSOP that further reduces board space.

## Applications

Desktop PC

Motherboards

Instruments

Equipment Meeting IEC1000-4-2

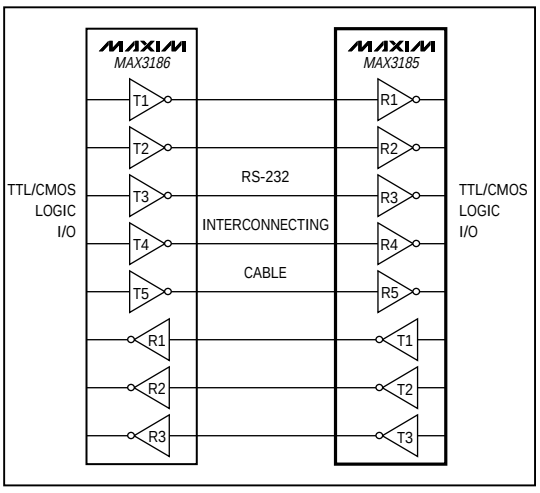
## Features

- ♦ **Enhanced ESD Protection:**
  **±15kV—Human Body Model**
  **±8kV—IEC1000-4-2, Contact Discharge**
  **±15kV—IEC1000-4-2, Air-Gap Discharge**
- ♦ **Latchup Free During an ESD Event**
- ♦ **20-Pin SSOP and SO Packages**
- ♦ **Guaranteed 230kbps Data Rate**
- ♦ **Flow-Through Pinout**
- ♦ **Pin Compatible with SN75C185**
- ♦ **Complete DTE Serial Port**

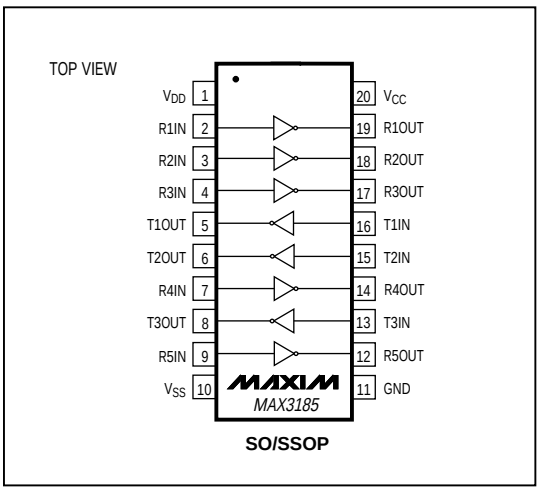
## Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|---|---|---|
| **MAX3185**CWP | 0°C to +70°C | 20 SO |
| MAX3185CAP | 0°C to +70°C | 20 SSOP |
| MAX3185EWP | -40°C to +85°C | 20 SO |
| MAX3185EAP | -40°C to +85°C | 20 SSOP |

## Typical Operating Circuit




## Pin Configuration




**SO/SSOP**



*For free samples & the latest literature: http://www.maxim-ic.com, or phone 1-800-998-8800*

# ±15kV ESD-Protected, EMC-Compliant, 230kbps RS-232 Serial Port for Motherboards/Desktop PCs

## 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
  MAX3185C_ P.....0°C to +70°C
  MAX3185E_ 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 | | 380 | 1500 | µA |
| | $I_{DD}$ | No load | | 185 | 500 | |
| | $I_{SS}$ | No load | | 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 |
| 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.)

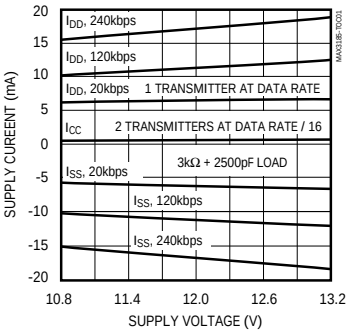
| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|---|
| **ESD CHARACTERISTICS** | | | | | | | |
| ESD Protection | | Human Body Model | | | ±15 | | kV |
| | | IEC1000-4-2 (Contact Discharge) | | | ±8 | | |
| | | IEC1000-4-2 (Air-Gap Discharge) | | | ±15 | | |
| **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 | |
| 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 | | | |
| Mouse Driveability | | T3OUT = -5mA, T1OUT = T2OUT = +5mA | | ±7.5 | | | V |

# ±15kV ESD-Protected, EMC-Compliant, 230kbps RS-232 Serial Port for Motherboards/Desktop PCs

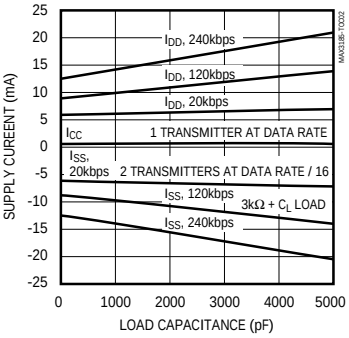
## Typical Operating Characteristics

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

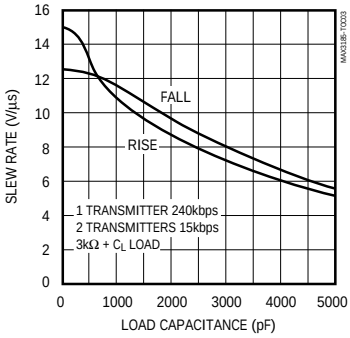
**SUPPLY CURRENT vs. SUPPLY VOLTAGE**



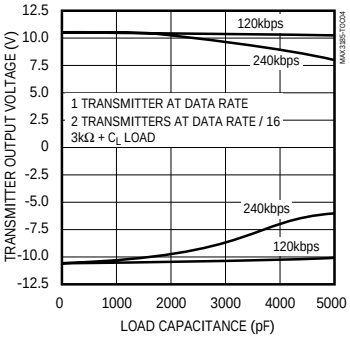

**SUPPLY CURRENT vs. LOAD CAPACITANCE**



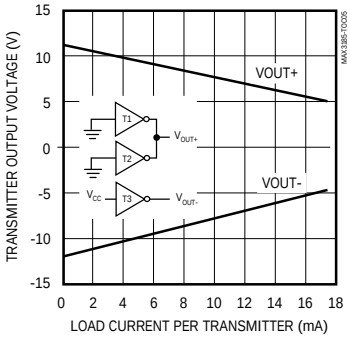

**SLEW RATE vs. LOAD CAPACITANCE**



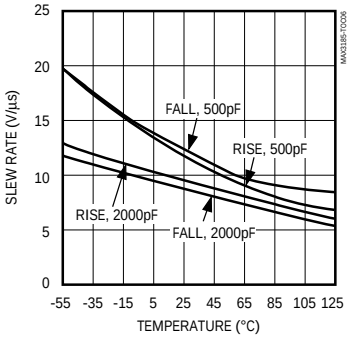

**TRANSMITTER OUTPUT VOLTAGE vs. LOAD CAPACITANCE**




**MAX3185 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 |
| 12, 14, 17, 18, 19 | R5OUT–R1OUT | Receiver Outputs, swing between GND and $V_{CC}$ |
| 16, 15, 13 | T3IN, T2IN, T1IN | Transmitter Inputs |
| 10 | $V_{SS}$ | Supply-Voltage Input, -10.8V to -13.2V |
| 11 | GND | Ground. Connect system to ground. |
| 2, 3, 4, 7, 9 | R1IN–R5IN | Receiver Inputs |
| 5, 6, 8 | T1OUT, T2OUT, T3OUT | Transmitter Outputs, swing between $V_{DD}$ and $V_{SS}$ |
| 20 | $V_{CC}$ | Supply-Voltage Input, +4.5V to +5.5V |

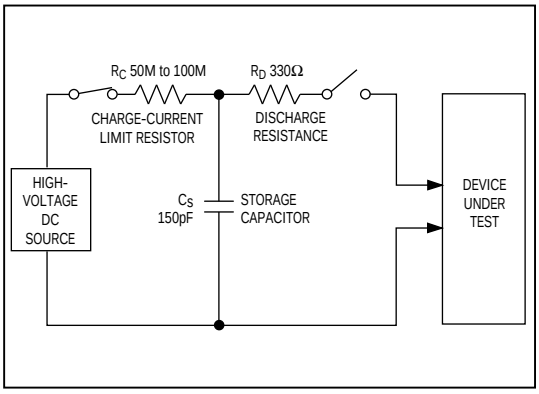



*Figure 1a. IEC1000-4-2 ESD Test Model*

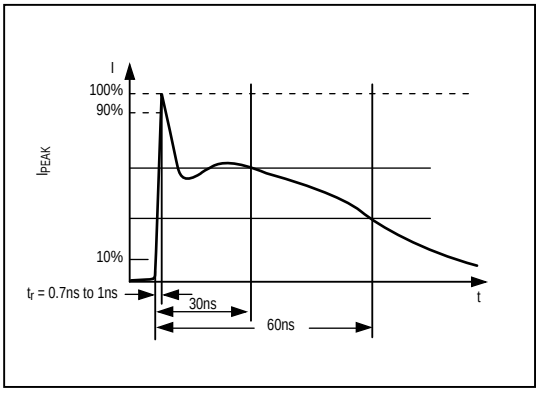



*Figure 1b. IEC1000-4-2 ESD-Generator Current Waveform*

## 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 MAX3185 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 MAX3185 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.

***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 MAX3185 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 that 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 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 unused transmitter inputs to GND or $V_{CC}$. No external protection diodes are needed because the MAX3185 is not sensitive to power-supply sequencing.

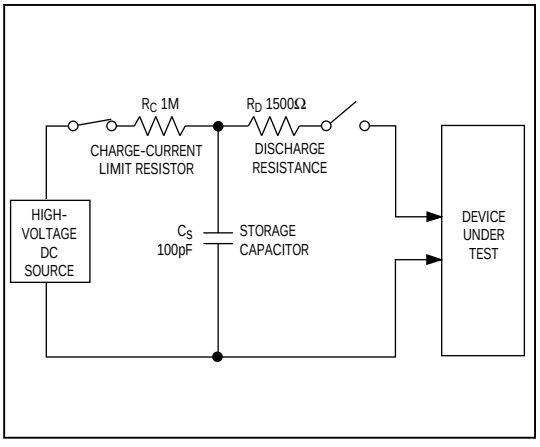



*Figure 2a. Human Body ESD Test Model*

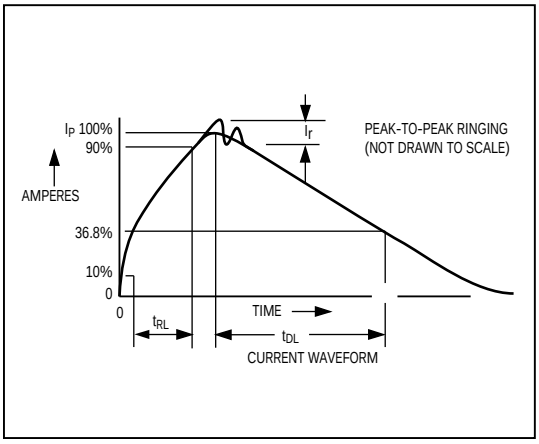



*Figure 2b. Human Body Model Current Waveform*

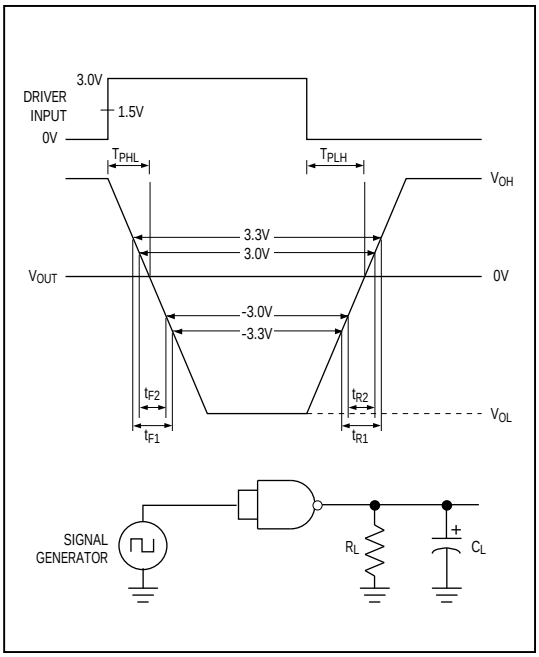


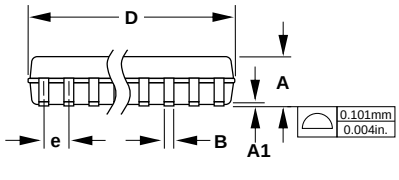

*Figure 3. Slew-Rate Test Circuit and Timing Diagram*

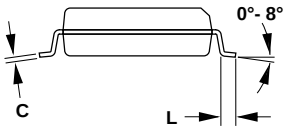
## Chip Information

TRANSISTOR COUNT: 217

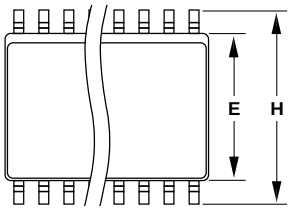
# ±15kV ESD-Protected, EMC-Compliant, 230kbps RS-232 Serial Port for Motherboards/Desktop PCs

## Package Information



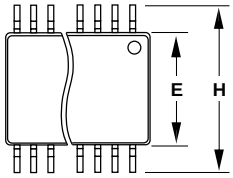

| DIM | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.093 | 0.104 | 2.35 | 2.65 |
| A1 | 0.004 | 0.012 | 0.10 | 0.30 |
| B | 0.014 | 0.019 | 0.35 | 0.49 |
| C | 0.009 | 0.013 | 0.23 | 0.32 |
| E | 0.291 | 0.299 | 7.40 | 7.60 |
| e | 0.050 | | 1.27 | |
| H | 0.394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

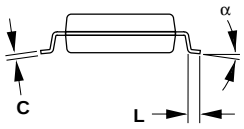



**Wide SO**
**SMALL-OUTLINE**
**PACKAGE**
**(0.300 in.)**

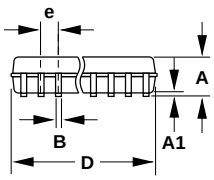
| DIM | PINS | INCHES | | MILLIMETERS | |
|---|---|---|---|---|---|
| | | MIN | MAX | MIN | MAX |
| D | 16 | 0.398 | 0.413 | 10.10 | 10.50 |
| D | 18 | 0.447 | 0.463 | 11.35 | 11.75 |
| D | 20 | 0.496 | 0.512 | 12.60 | 13.00 |
| D | 24 | 0.598 | 0.614 | 15.20 | 15.60 |
| D | 28 | 0.697 | 0.713 | 17.70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

21-0042A




| 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° |




**SSOP**
**SHRINK**
**SMALL-OUTLINE**
**PACKAGE**

| 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 |

21-0056A

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