FEATURES

- Operates from Single +5V Power Supply
- Meets All RS-232F and ITU V.28 Specifications
- Operates with 0.1μF to 1μF Capacitors
- High Data Rate – 120Kbps Under Load
- Low Power CMOS – 3mA Operation (SP232A)
- No External Capacitors Required (SP233A)
- Low Power Shutdown (SP310A,SP312A)
- Enhanced ESD Protection (2kV Human Body Model)

DESCRIPTION

The SP232A/233A/310A/312A devices are a family of line driver and receiver pairs that meet the specifications of RS-232 and V.28 serial protocols. These devices are pin-to-pin compatible with popular industry standards. As with the initial versions, the SP232A/233A/310A/312A devices feature at least 120Kbps data rate under load, 0.1μF charge pump capacitors, and overall ruggedness for commercial applications. This family also features Sipex's BiCMOS design allowing low power operation without sacrificing performance. The series is available in plastic DIP and SOIC packages operating over the commercial and industrial temperature ranges.

SELECTION TABLE

<table>
<thead>
<tr>
<th>Model</th>
<th>Number of RS232 Drivers</th>
<th>No. of Receivers Active in Shutdown</th>
<th>No. of External 0.1μF Capacitors</th>
<th>Shutdown</th>
<th>WakeUp</th>
<th>TTL Tri–State</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP232A</td>
<td>2</td>
<td>N/A</td>
<td>4</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SP233A</td>
<td>2</td>
<td>N/A</td>
<td>0</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SP310A</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SP312A</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Now Available in Lead Free Packaging
This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

ABSOLUTE MAXIMUM RATINGS

Output Voltages
- \( V_{out} \) (\( V_+ \), +0.3V) to (\( V_- \), -0.3V)
- \( R_{out} \) (-0.3V to (\( V_+ \) +0.3V)

Short Circuit Duration
- \( T_{out} \) Continuous

Plastic DIP
- 375mW (derate 7mW/°C above +70°C)
- Small Outline
- 375mW (derate 7mW/°C above +70°C)

V\(_{CC}\) = +5V ±10%; 0.1µF charge pump capacitors; \( T_{MIN} \) to \( T_{MAX} \) unless otherwise noted.

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNITS</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>V(_{OUT})</td>
<td>(( V_+ ), +0.3V) to (( V_- ), -0.3V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R(_{OUT})</td>
<td>-0.3V to (( V_+ ) +0.3V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Voltages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( T_{IN} )</td>
<td>-0.3 to (( V_+ ) +0.3V)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( R_{IN} )</td>
<td>±30V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

V\(_{CC}\) = +5V

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNITS</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTL INPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic Threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic Pull-Up Current</td>
<td>2.0</td>
<td>15</td>
<td>200</td>
<td>µA</td>
<td>( T_{IN} ); ( EN, SD )</td>
</tr>
</tbody>
</table>

TTL/CMOS Output

- Voltage, Low | 3.5 | 0.4 | Volts |
- Voltage, High | | | Volts |
- Leakage Current; \( T_A = +25 \) °C | 0.05 | ±10 | µA | \( EN= V_{CC}, ZeroV \leq V_{OUT} \leq V_{CC} \) | SP310A and SP312A only |

RS-232 OUTPUT

- Output Voltage Swing | ±5 | ±6 | Volts | All transmitter outputs loaded with 3kΩ to Ground |
- Output Resistance | 300 | ±18 | Ohms |
- Output Short Circuit Current | 120 | 240 | mA | Infinite duration |
- Maximum Data Rate | | | Kbps | \( C_L = 2500pF, R_L = 3kΩ \) |

RS-232 INPUT

- Voltage Range | -30 | +30 | Volts |
- Voltage Threshold | | | Volts |
| LOW | 0.8 | 1.2 | Volts | \( V_{CC}= 5V, T_A= +25 \) °C |
| HIGH | 1.7 | 2.4 | Volts | \( V_{CC}= 5V, T_A= +25 \) °C |
| Hysteresis | 0.2 | 0.5 | 1.0 | Volts | \( V_{CC}= 5V, T_A= +25 \) °C |
| Resistance | 3 | 5 | 7 | kΩ | \( T_A= +25 \) °C, -15V ≤\( V_+ \) ≤ +15V |

DYNAMIC CHARACTERISTICS

- Driver Propagation Delay | 1.5 | 3.0 | µs | TTL to RS-232; \( C_L= 50pF \) |
- Receiver Propagation Delay | 0.1 | 1.0 | µs | RS-232 to TTL |
- Instantaneous Slew Rate | | | 30 | V/µs |
| Transition Region Slew Rate | 10 | | V/µs | \( C_L= 2500pF, R_L = 3kΩ \); measured from +3V to -3V or -3V to +3V |
- Output Enable Time | 400 | ns |
- Output Disable Time | 250 | ns |

POWER REQUIREMENTS

- \( V_{CC}\) Power Supply Current
| SP232A | 3 | 5 | mA | No load, \( T_A= +25\) °C; \( V_{CC}= 5V \) |
| SP233A, SP310A, SP312A | 10 | 15 | mA | No load, \( T_A= +25\) °C; \( V_{CC}= 5V \) |
- \( V_{CC}\) Supply Current, Loaded
| SP232A | 15 | mA | All transmitters \( R_L = 3kΩ \); \( T_A = +25 \) °C |
| SP233A, SP310A, SP312A | 25 | mA | All transmitters \( R_L = 3kΩ \); \( T_A = +25 \) °C |
- Shutdown Supply Current
| SP310A, SP312A | 1 | 10 | µA | \( V_{CC}= 5V, T_A= +25 \) °C |
**PERFORMANCE CURVES**

- Temperature (°C)
  - -55, -40, 0, 25, 70, 85, 125

- Load Current (mA)
  - 0, 5, 10, 15, 20

- VCC = 6V
  - V+ (Volts)
    - 2, 4, 6, 8, 10
  - VCC = 5V
  - VCC = 4V
  - VCC = 3V

- Load Current (mA)
  - 0, 2, 4, 6, 8, 10, 12, 14

- VCC = 6V
  - VCC = 5V
  - VCC = 4V

**PINOUTS**

- SP232A
  - Pins: C1+, V+, C1-, C2+, C2-, V-, T2OUT, R1IN, 1-16
  - Connections: GND, VCC

- SP233ACT/AET
  - Pins: T1IN, R1IN, R1OUT, T1OUT, V+, GND, 1-20
  - Connections: NC, ON/OFF, 20-PIN SOIC

- SP310A
  - Pins: T2IN, C1+, C1-, C2+, C2-, V+, VCC, GND, T2OUT, R1IN, 1-18
  - Connections: NC, EN, SHUTDOWN, 20-PIN PLASTIC DIP

- SP312A
  - Pins: C1+, C1-, C2+, C2-, V+, VCC, GND, T2OUT, R1IN, 1-18
  - Connections: NC, EN, SHUTDOWN, 20-PIN PLASTIC DIP

* N.C. for SP310E_A, EN for SP312E_A

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Not 100% tested.
FEATURES...

The **SP232A/233A/310A/312A** devices are a family of line driver and receiver pairs that meet the specifications of RS-232 and V.28 serial protocols. The ESD tolerance has been improved on these devices to over ±2KV for the Human Body Model. These devices are pin-to-pin compatible with popular industry standards.

The **SP232A/233A/310A/312A** devices feature 10V/µs slew rate, 120Kbps data rate under load, 0.1µF charge pump capacitors, overall ruggedness for commercial applications, and increased drive current for longer and more flexible cable configurations. This family also features Sipex's BiCMOS design allowing low power operation without sacrificing performance.

The **SP232A/233A/310A/312A** devices have internal charge pump voltage converters which allow them to operate from a single +5V supply. The charge pumps will operate with polarized or non-polarized capacitors ranging from 0.1 to µF and will generate the ±6V needed for the RS-232 output levels. Both meet all EIA RS-232F and ITU V.28 specifications.

The **SP310A** provides identical features as the **SP232A** with the addition of a single control line which simultaneously shuts down the internal DC/DC converter and puts all transmitter and receiver outputs into a high impedance state. The **SP312A** is identical to the **SP310A** with separate tri-state and shutdown control lines.

THEORY OF OPERATION

The **SP232A**, **SP233A**, **SP310A** and **SP312A** devices are made up of three basic circuit blocks – 1) a driver/transmitter, 2) a receiver and 3) a charge pump. Each block is described below.

**Driver/Transmitter**

The drivers are inverting transmitters, which accept TTL or CMOS inputs and output the RS-232 signals with an inverted sense relative to the input logic levels. Typically the RS-232 output voltage swing is ±6V. Even under worst case loading conditions of 3kOhms and 2500pF, the output is guaranteed to be ±5V, which is consistent with the RS-232 standard specifications. The transmitter outputs are protected against infinite short-circuits to ground without degradation in reliability.

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*The negative terminal of the V+ storage capacitor can be tied to either VCC or GND. Connecting the capacitor to VCC(±5V) is recommended.

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**Figure 1. Typical Circuit using the SP232A.**
Figure 2. Typical Circuits using the SP233ACP and SP233ACT

The instantaneous slew rate of the transmitter output is internally limited to a maximum of 30V/μs in order to meet the standards [EIA RS-232-F]. The transition region slew rate of these enhanced products is typically 10V/μs. The smooth transition of the loaded output from \( V_{\text{OL}} \) to \( V_{\text{OH}} \) clearly meets the monotonicity requirements of the standard [EIA RS-232-F].

Receivers

The receivers convert RS-232 input signals to inverted TTL signals. Since the input is usually from a transmission line, where long cable lengths and system interference can degrade the signal, the inputs have a typical hysteresis margin of 500mV. This ensures that the receiver is virtually immune to noisy transmission lines.

The input thresholds are 0.8V minimum and 2.4V maximum, again well within the ±3V RS-232 requirements. The receiver inputs are also protected against voltages up to ±25V. Should an input be left unconnected, a 5KΩ pulldown resistor to ground will commit the output of the receiver to a high state.

Figure 3. Typical Circuits using the SP310A and SP312A

*The negative terminal of the \( V_{\text{cc}} \) storage capacitor can be tied to either \( V_{\text{cc}} \) or GND. Connecting the capacitor to \( V_{\text{cc}} (1.4\text{V}) \) is recommended.
In actual system applications, it is quite possible for signals to be applied to the receiver inputs before power is applied to the receiver circuitry. This occurs, for example, when a PC user attempts to print, only to realize the printer wasn’t turned on. In this case an RS-232 signal from the PC will appear on the receiver input at the printer. When the printer power is turned on, the receiver will operate normally. All of these enhanced devices are fully protected.

**Charge Pump**

The charge pump is a Sipex-patented design (5,306,954) and uses a unique approach compared to older less-efficient designs. The charge pump still requires four external capacitors, but uses a four-phase voltage shifting technique to attain symmetrical power supplies. There is a free-running oscillator that controls the four phases of the voltage shifting. A description of each phase follows.

**Phase 1**

— V<sub>SS</sub> charge storage — During this phase of the clock cycle, the positive side of capacitors C<sub>1</sub> and C<sub>2</sub> are initially charged to +5V. C<sub>1</sub><sup>+</sup> is then switched to ground and the charge in C<sub>1</sub><sup>−</sup> is transferred to C<sub>2</sub><sup>−</sup>. Since C<sub>2</sub><sup>+</sup> is connected to +5V, the voltage potential across capacitor C<sub>2</sub> is now 10V.

**Phase 2**

— V<sub>SS</sub> transfer — Phase two of the clock connects the negative terminal of C<sub>2</sub> to the V<sub>SS</sub> storage capacitor and the positive terminal of C<sub>2</sub> to ground, and transfers the generated −10V to C<sub>3</sub>. Simultaneously, the positive side of capacitor C<sub>1</sub> is switched to +5V and the negative side is connected to ground.

**Phase 3**

— V<sub>DD</sub> charge storage — The third phase of the clock is identical to the first phase — the charge transferred in C<sub>1</sub> produces −5V in the negative terminal of C<sub>1</sub><sup>−</sup>, which is applied to the negative side of capacitor C<sub>2</sub>. Since C<sub>2</sub><sup>+</sup> is at +5V, the voltage potential across C<sub>2</sub> is a maximum of 10V.

**Phase 4**

— V<sub>DD</sub> transfer — The fourth phase of the clock connects the negative terminal of C<sub>2</sub> to ground, and transfers the generated 10V across C<sub>2</sub> to C<sub>4</sub>, the V<sub>DD</sub> storage capacitor. Again, simultaneously with this, the positive side of capacitor C<sub>1</sub> is switched to +5V and the negative side is connected to ground, and the cycle begins again.

Since both V<sup>+</sup> and V<sup>−</sup> are separately generated from V<sub>CC</sub>; in a no-load condition V<sup>+</sup> and V<sup>−</sup> will be symmetrical. Older charge pump approaches...
that generate $V^-$ from $V^+$ will show a decrease in
the magnitude of $V^-$ compared to $V^+$ due to the
inherent inefficiencies in the design.

The clock rate for the charge pump typically
operates at greater than 15kHz. The external
capacitors can be as low as 0.1µF with a 10V
breakdown voltage rating.

**Shutdown (SD) and Enable (EN) for the**
**SP310A and SP312A**

Both the SP310A and SP312A have a shutdown/
standby mode to conserve power in battery-pow-
ered systems. To activate the shutdown mode,
which stops the operation of the charge pump, a
logic “0” is applied to the appropriate control line.
For the SP310A, this control line is ON/OFF (pin
18). Activating the shutdown mode also puts the
SP310A transmitter and receiver outputs in a high impedance condition (tri-stated). The shutdown mode is controlled on the SP312A by a logic “0” on the SHUTDOWN control line (pin 18); this also puts the transmitter outputs in a tri–state mode. The receiver outputs can be tri–stated separately during normal operation or shutdown by a logic “1” on the ENABLE line (pin 1).

Wake-Up Feature for the SP312A

The SP312A has a wake–up feature that keeps all the receivers in an enabled state when the device is in the shutdown mode. Table 1 defines the truth table for the wake–up function.

With only the receivers activated, the SP312A typically draws less than 5µA supply current. In the case of a modem interfaced to a computer in power down mode, the Ring Indicator (RI) signal from the modem would be used to "wake up" the computer, allowing it to accept data transmission.

After the ring indicator signal has propagated through the SP312A receiver, it can be used to trigger the power management circuitry of the computer to power up the microprocessor, and bring the SD pin of the SP312A to a logic high, taking it out of the shutdown mode. The receiver propagation delay is typically 1µs. The enable time for V+ and V− is typically 2ms. After V+ and V− have settled to their final values, a signal can be sent back to the modem on the data terminal ready (DTR) pin signifying that the computer is ready to accept and transmit data.

Pin Strapping for the SP233ACT/ACP

The SP233A packaged in the 20–pin SOIC package (SP233ACT) has a slightly different pinout than the SP233A in PDIP packaging (SP233ACP). To operate properly, the following pairs of pins must be externally wired together:

<table>
<thead>
<tr>
<th>Pins Wired Together</th>
<th>SOIC</th>
<th>PDIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two V- Pins</td>
<td>10 &amp; 17</td>
<td>12 &amp; 17</td>
</tr>
<tr>
<td>Two C2+ Pins</td>
<td>12 &amp; 15</td>
<td>11 &amp; 15</td>
</tr>
<tr>
<td>Two C2- Pins</td>
<td>11 &amp; 16</td>
<td>10 &amp; 16</td>
</tr>
<tr>
<td>No Connections for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pins 8, 13, and 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connect Pins 6 and 9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to GND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Wake-up Function Truth Table.
### Package: 20 Pin PDIP

#### Dimensions

**Top View**
- **E1**: 0.020
- **E2**: 0.022
- **F1**: 0.039
- **F2**: 0.046
- **G1**: 0.035
- **G2**: 0.039
- **H1**: 0.039
- **H2**: 0.041
- **I1**: 0.020
- **I2**: 0.022
- **J1**: 0.039
- **J2**: 0.041
- **K**: 0.043
- **L1**: 0.035
- **L2**: 0.039
- **M**: 0.039
- **N**: 0.046
- **P**: 0.020
- **Q**: 0.022
- **R**: 0.035
- **S**: 0.039
- **T**: 0.046
- **U**: 0.035
- **V**: 0.039
- **W**: 0.046
- **X**: 0.035
- **Y**: 0.039
- **Z**: 0.046

**Side View**
- **A1**: 0.030
- **A2**: 0.030
- **B1**: 0.020
- **B2**: 0.022
- **C1**: 0.035
- **C2**: 0.039
- **D1**: 0.044 (4x)
- **D2**: 0.034
- **E1**: 0.030
- **E2**: 0.032
- **F**: 0.039
- **G**: 0.039
- **H**: 0.046
- **I**: 0.035
- **J**: 0.039
- **K**: 0.046
- **L**: 0.035
- **M**: 0.039
- **N**: 0.046
- **O**: 0.035
- **P**: 0.039
- **Q**: 0.046
- **R**: 0.035
- **S**: 0.039
- **T**: 0.046
- **U**: 0.035
- **V**: 0.039
- **W**: 0.046
- **X**: 0.035
- **Y**: 0.039
- **Z**: 0.046

**Front View**
- **a**: 0.030
- **b**: 0.030
- **c**: 0.030
- **d**: 0.030
- **e**: 0.030
- **f**: 0.030
- **g**: 0.030
- **h**: 0.030
- **i**: 0.030
- **j**: 0.030
- **k**: 0.030
- **l**: 0.030
- **m**: 0.030
- **n**: 0.030

### Symbols

- **N**: Number
- **V**: Voltage
- **R**: Resistance (ohm)

### Definitions

- **E**: Electrical
- **F**: Flip-flop
- **G**: Ground
- **I**: Input
- **O**: Output
- **P**: Power
- **R**: Reference
- **S**: Signal
- **V**: Voltage

### Notes

- **Unit**: Inch
- **Revision**: A
- **Drawn By**: Apr0
- **Checked By**: Aqi
- **Approved By**: Apr0
- **Date**: 04/30/06
- **Document No**: 20 Pin PDIP

### Revision History

- Revision A
- Date: 04/30/06
- Document No: 20 Pin PDIP
- Package: 20 Pin PDIP

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**Packaging Outline**

**Pin #1**

- **B**: 0.030
- **D**: 0.046
- **E**: 0.030
- **F**: 0.030
- **G**: 0.046
- **H**: 0.030
- **I**: 0.046
- **J**: 0.030
- **K**: 0.030
- **L**: 0.046
- **M**: 0.030
- **N**: 0.046
- **O**: 0.030
- **P**: 0.046
- **Q**: 0.030
- **R**: 0.046
- **S**: 0.030
- **T**: 0.046
- **U**: 0.030
- **V**: 0.046
- **W**: 0.030
- **X**: 0.046
- **Y**: 0.030
- **Z**: 0.046

**Remarks**

- **All Half Lead Types**
- **All END Lead Types (4x)**
- **For BUD AND 16LD**

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**Notes**

- **Packaging**: 20 Pin PDIP
- **Date**: 01/31/07
- **Rev B**
- **SP232A/233A/30A/32A © 2007 Sipex Corporation**

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**Package**: 20 Pin PDIP

**Dimensions**: MS-001 Variation AD

---

**Symbols**

- **N**: Number
- **V**: Voltage
- **R**: Resistance (ohm)

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**Definitions**

- **E**: Electrical
- **F**: Flip-flop
- **G**: Ground
- **I**: Input
- **O**: Output
- **P**: Power
- **R**: Reference
- **S**: Signal
- **V**: Voltage
<table>
<thead>
<tr>
<th>Part Number</th>
<th>Temperature Range</th>
<th>Topmark</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP310AET/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP310ACT</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP310ACP</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin PDIP</td>
</tr>
<tr>
<td>SP310ACT/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>20-pin WSOIC</td>
</tr>
<tr>
<td>SP310ACT</td>
<td>–40°C to +85°C</td>
<td></td>
<td>20-pin WSOIC</td>
</tr>
<tr>
<td>SP310ACP</td>
<td>–40°C to +85°C</td>
<td></td>
<td>20-pin PDIP</td>
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<td>SP310ACP/TR</td>
<td>–40°C to +85°C</td>
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<td>20-pin PDIP</td>
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<td>SP310ACT</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP310ACT/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP310ACP</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin PDIP</td>
</tr>
<tr>
<td>SP310ACP/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin PDIP</td>
</tr>
<tr>
<td>SP312AET</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP312AET/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP312ACT</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin WSOIC</td>
</tr>
<tr>
<td>SP312ACT/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>18-pin WSOIC</td>
</tr>
<tr>
<td>SP312ACP</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin PDIP</td>
</tr>
<tr>
<td>SP312ACP/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin PDIP</td>
</tr>
<tr>
<td>SP312ACT</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin WSOIC</td>
</tr>
<tr>
<td>SP312ACT/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin WSOIC</td>
</tr>
<tr>
<td>SP312ACP</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin WSOIC</td>
</tr>
<tr>
<td>SP312ACP/TR</td>
<td>–40°C to +85°C</td>
<td></td>
<td>16-pin WSOIC</td>
</tr>
</tbody>
</table>

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SP312AEA/TR = standard; SP312AEA-L/TR = lead free.

/TR = Tape and Reel
Pack quantity is 1,500 for WSOIC and 2,500 for NSOIC.