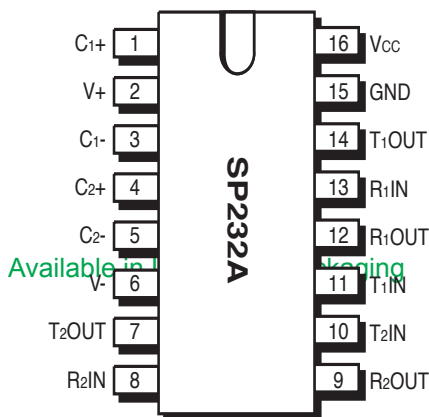


Enhanced RS-232 Line Drivers/Receivers

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)



Now Available in Lead Free Packaging

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

| Model | Number of RS232 | | No. of Receivers Active in Shutdown | No. of External 0.1µF Capacitors | Shutdown | WakeUp | TTL Tri-State |
|---------------|-----------------|-----------|-------------------------------------|----------------------------------|----------|--------|---------------|
| | Drivers | Receivers | | | | | |
| SP232A | 2 | 2 | N/A | 4 | No | No | No |
| SP233A | 2 | 2 | N/A | 0 | No | No | No |
| SP310A | 2 | 2 | 0 | 4 | Yes | No | Yes |
| SP312A | 2 | 2 | 2 | 4 | Yes | Yes | Yes |

ABSOLUTE MAXIMUM RATINGS

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.

| | |
|-----------------------|-----------------------------------|
| V ^{CC} | +6V |
| V ⁺ | (V _{CC} -0.3V) to +11.0V |
| V ⁻ | -11.0V |
| Input Voltages | |
| T _{IN} | -0.3 to (V _{CC} +0.3V) |
| R _{IN} | ±30V |

Output Voltages

| | |
|-----------------------------|--|
| T _{OUT} | (V ₊ , +0.3V) to (V ₋ , -0.3V) |
| F _{OUT} | -0.3V to (V _{CC} +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) | |

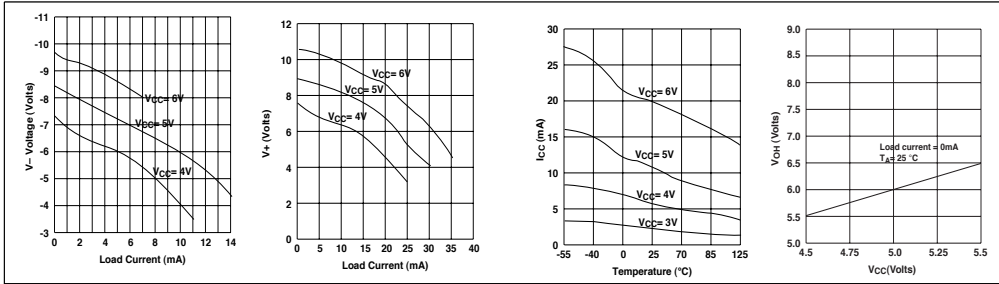
ELECTRICAL CHARACTERISTICS

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

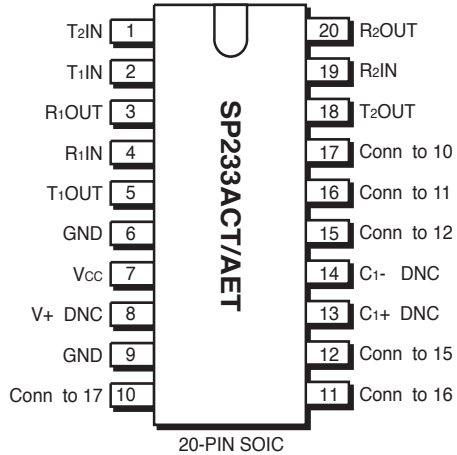
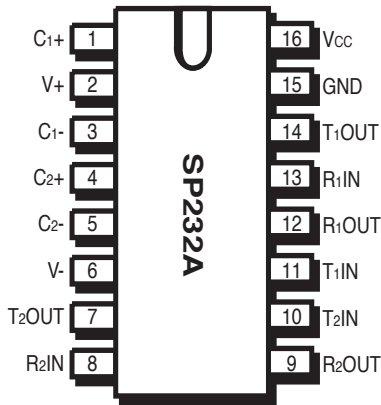
| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|---|------|------|------|-------|---|
| TTL INPUT | | | | | |
| Logic Threshold | | | | | |
| LOW | | | 0.8 | Volts | $T_{IN} \cdot \overline{EN}, \overline{SD}$ |
| HIGH | 2.0 | | | Volts | $T_{IN} \cdot \overline{EN}, \overline{SD}$ |
| Logic Pull-Up Current | | 15 | 200 | µA | T _{IN} = ZeroV |
| TTL OUTPUT | | | | | |
| TTL/CMOS Output | | | | | |
| Voltage, Low | | | 0.4 | Volts | I _{OUT} = 3.2mA; V _{CC} = +5V |
| Voltage, High | 3.5 | | | Volts | I _{OUT} = -1.0mA |
| Leakage Current; T _A = +25 ° | | 0.05 | ±10 | µA | $\overline{EN} = V_{CC}, \text{ZeroV} \leq V_{OUT} \leq V_{CC}$ SP310A and SP312A only |
| RS-232 OUTPUT | | | | | |
| Output Voltage Swing | ±5 | ±6 | | Volts | All transmitter outputs loaded with 3kΩ to Ground |
| Output Resistance | 300 | | | Ohms | V _{CC} = ZeroV; V _{OUT} = ±2V |
| Output Short Circuit Current | | ±18 | | mA | Infinite duration |
| Maximum Data Rate | 120 | 240 | | Kbps | C _L = 2500pF, R _L = 3kΩ |
| RS-232 INPUT | | | | | |
| Voltage Range | -30 | | +30 | Volts | |
| Voltage Threshold | | | | | |
| 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 _{IN} ≤ +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 | C _L = 10pF, R _L = 3-7kΩ; T _A = +25 °C |
| 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 | SP310A and SP312A only |
| Output Disable Time | | 250 | | ns | SP310A and SP312A only |
| 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 = 3k Ω; T _A = +25 °C |
| SP233A, SP310A, SP312A | | 25 | | mA | All transmitters R _L = 3k Ω; T _A = +25 °C |
| Shutdown Supply Current | | | | | |
| SP310A, SP312A | | 1 | 10 | µA | V _{CC} = 5V, T _A = +25 °C |

PERFORMANCE CURVES

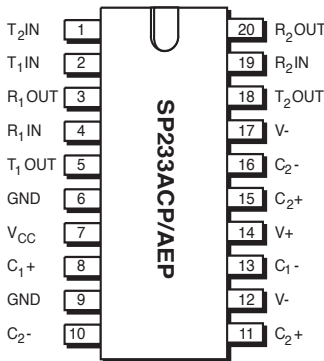
Not 100% tested.



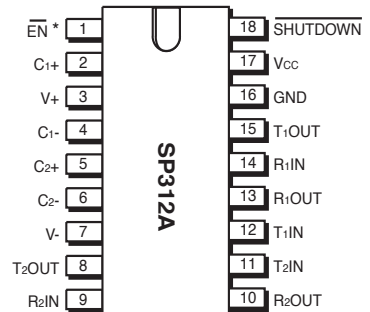
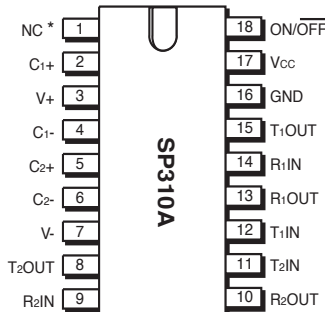
PINOUTS



See Figure 2 for Pin Connections



20-PIN PLASTIC DIP



* N.C. for SP310E_A, EN for SP312E_A

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 $\pm 2\text{KV}$ for the Human Body Model. These devices are pin-to-pin compatible with popular industry standards. The **SP232A/233A/310A/312A** devices feature $10\text{V}/\mu\text{s}$ slew rate, 120Kbps data rate under load, $0.1\mu\text{F}$ 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 $+5\text{V}$ supply. The charge pumps will operate with polarized or non-polarized capacitors ranging from 0.1 to μF and will generate the $\pm 6\text{V}$ 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 $\pm 6\text{V}$. Even under worst case loading conditions of $3\text{k}\Omega$ and 2500pF , the output is guaranteed to be $\pm 5\text{V}$, which is consistent with the RS-232 standard specifications. The transmitter outputs are protected against infinite short-circuits to ground without degradation in reliability.

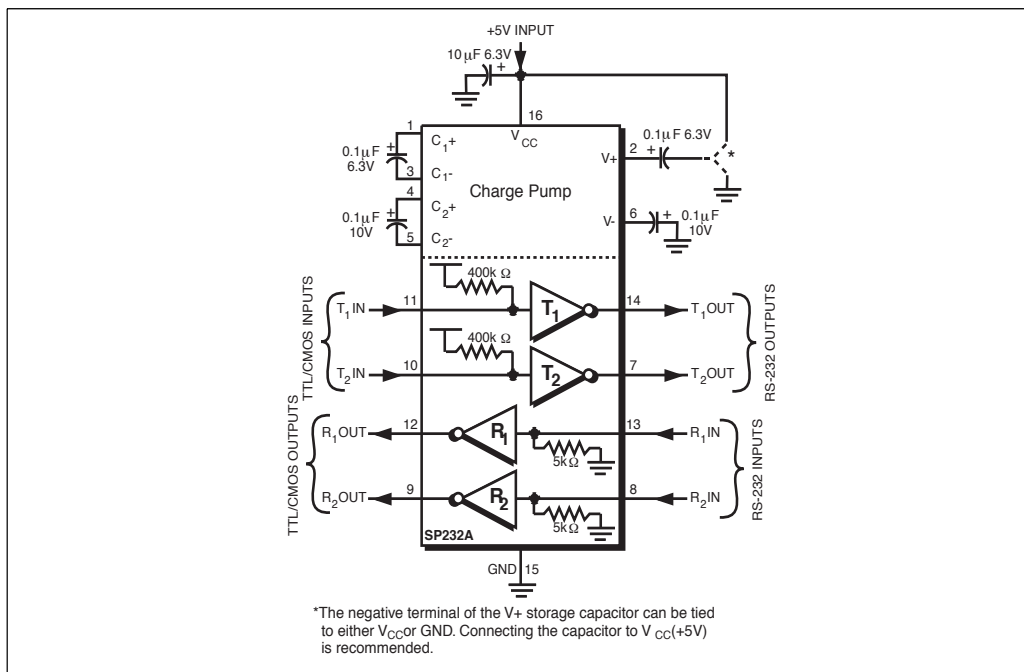


Figure 1. Typical Circuit using the SP232A.

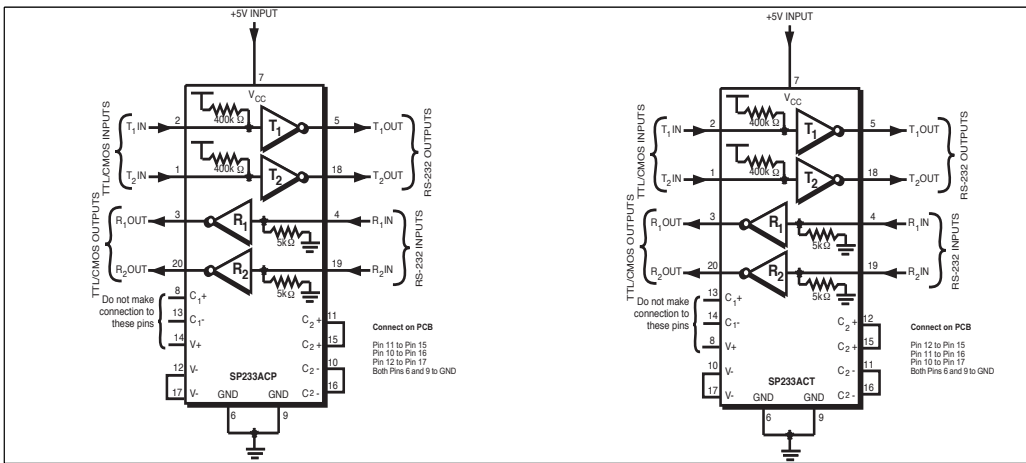


Figure 2. Typical Circuits using the SP233ACP and SP233ACT

The instantaneous slew rate of the transmitter output is internally limited to a maximum of 30V/ μ s in order to meet the standards [EIA RS-232-F]. The transition region slew rate of these enhanced products is typically 10V/ μ s. The smooth transition of the loaded output from V_{OL} to V_{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 \pm 3V RS-232 requirements. The receiver inputs are also protected against voltages up to \pm 25V. Should an input be left unconnected, a 5K Ω pull-down resistor to ground will commit the output of the receiver to a high state.

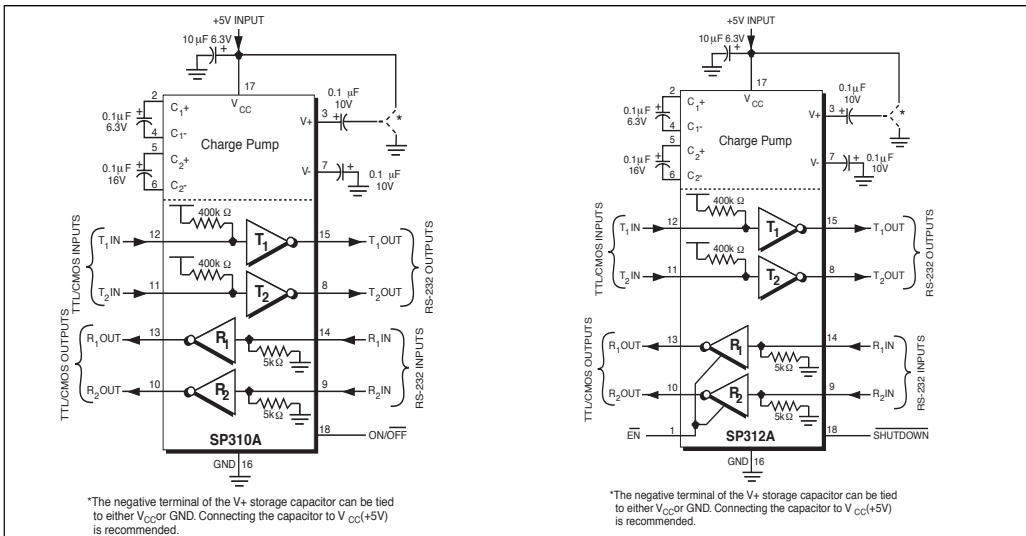


Figure 3. Typical Circuits using the SP310A and SP312A

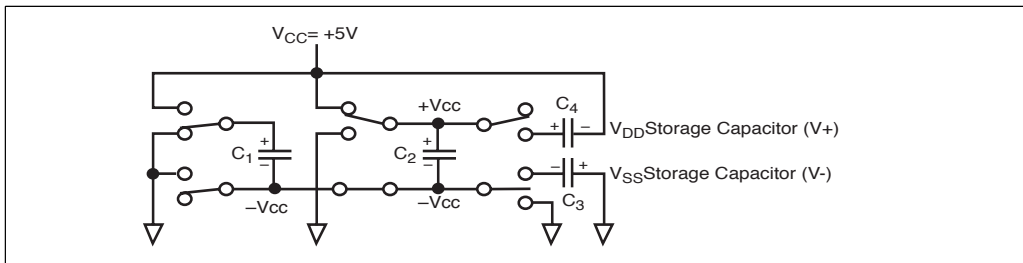


Figure 4. Charge Pump — Phase 1

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_{SS} charge storage — During this phase of the clock cycle, the positive side of capacitors C_1 and C_2 are initially charged to +5V. C_1^+ is then switched to ground and the charge in C_1^- is transferred to C_2^- . Since C_2^+ is connected to +5V, the voltage potential across capacitor C_2 is now 10V.

Phase 2

— V_{SS} transfer — Phase two of the clock connects the negative terminal of C_2 to the V_{SS} storage capacitor and the positive terminal of C_2 to ground, and transfers the generated -10V to C_3 . Simultaneously, the positive side of capacitor C_1 is switched to +5V and the negative side is connected to ground.

Phase 3

— V_{DD} charge storage — The third phase of the clock is identical to the first phase — the charge transferred in C_1 produces -5V in the negative terminal of C_1 , which is applied to the negative side of capacitor C_2 . Since C_2^+ is at +5V, the voltage potential across C_2 is a maximum of 10V.

Phase 4

— V_{DD} transfer — The fourth phase of the clock connects the negative terminal of C_2 to ground, and transfers the generated 10V across C_2 to C_4 , the V_{DD} storage capacitor. Again, simultaneously with this, the positive side of capacitor C_1 is switched to +5V and the negative side is connected to ground, and the cycle begins again.

Since both V^+ and V^- are separately generated from V_{CC} ; in a no-load condition V^+ and V^- will be symmetrical. Older charge pump approaches

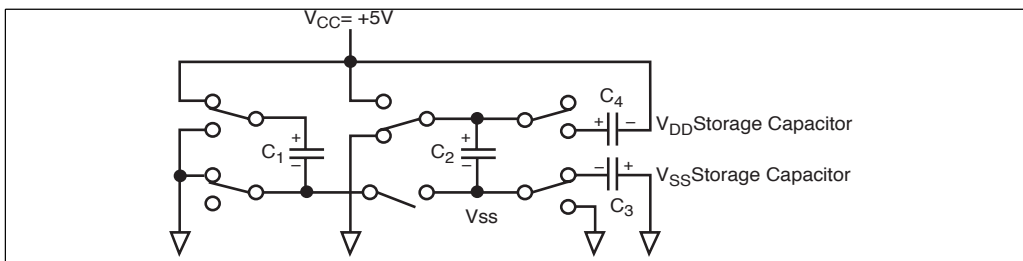


Figure 5. Charge Pump — Phase 2

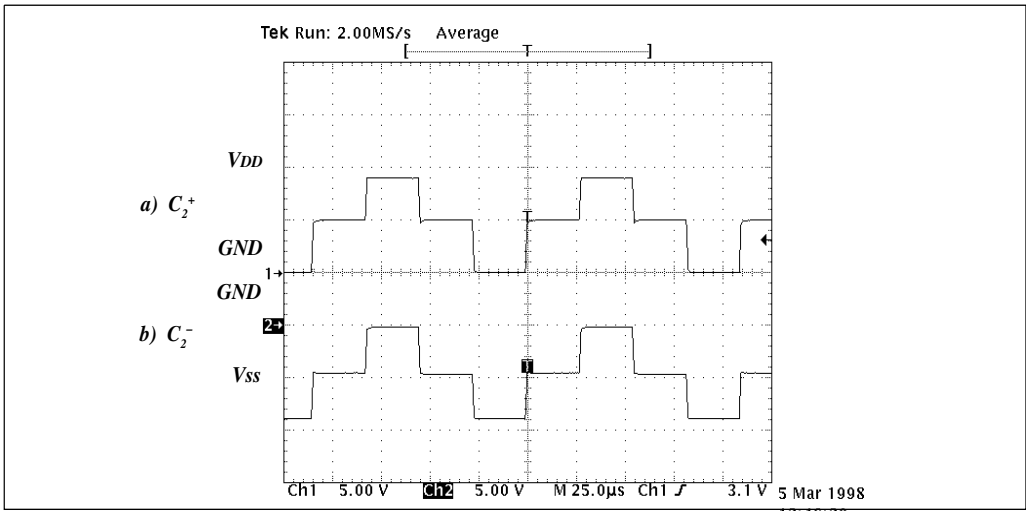


Figure 6. Charge Pump Waveforms

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-powered 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

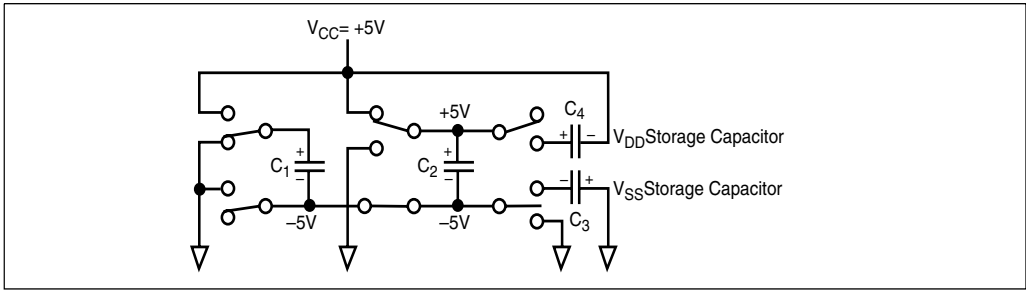


Figure 7. Charge Pump — Phase 3

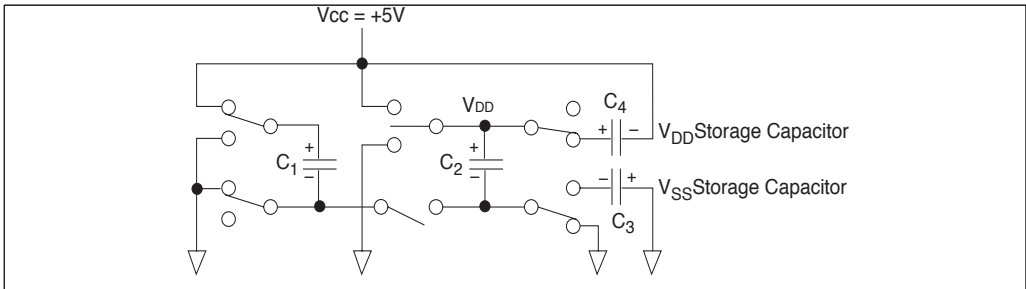


Figure 8. Charge Pump — Phase 4

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 $\overline{\text{SHUTDOWN}}$ 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 5 μ A 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 $\overline{\text{SD}}$ pin of the **SP312A** to a logic high, taking it out of the shutdown mode. The receiver propagation delay is typically 1 μ s. 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.

| $\overline{\text{SD}}$ | $\overline{\text{EN}}$ | Power Up/Down | Receiver Outputs |
|------------------------|------------------------|---------------|------------------|
| 0 | 0 | Down | Enable |
| 0 | 1 | Down | Tri-state |
| 1 | 0 | Up | Enable |
| 1 | 1 | Up | Tri-state |

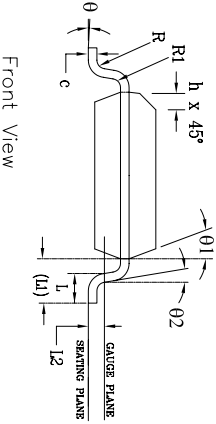
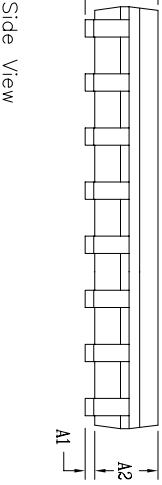
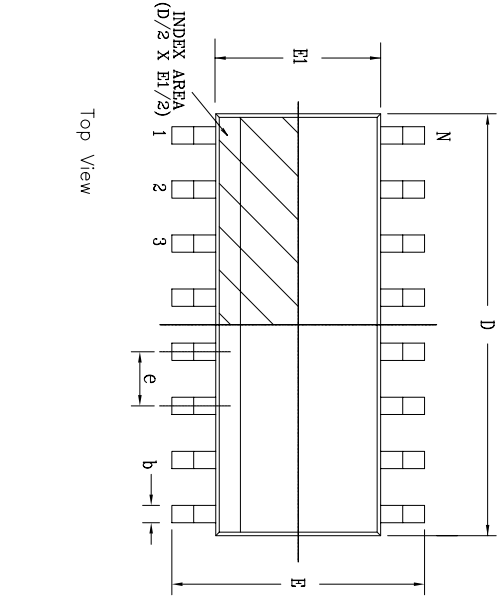
Table 1. Wake-up Function Truth Table.

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:

| Pins Wired Together | SOIC | PDIP |
|---------------------|---------------------------------------|---------|
| Two V- Pins | 10 & 17 | 12 & 17 |
| Two C2+ Pins | 12 & 15 | 11 & 15 |
| Two C2- Pins | 11 & 16 | 10 & 16 |
| | No Connections for Pins 8, 13, and 14 | |
| | Connect Pins 6 and 9 to GND | |

| REVISION HISTORY | | | |
|------------------|-----------------------------|----------|-------|
| REV. | DESCRIPTION | DATE | APP'D |
| A | DRAWING ORIENTATION | 10/12/05 | JL |
| B | DRAWING FORMAT MODIFICATION | 07/19/06 | JL |



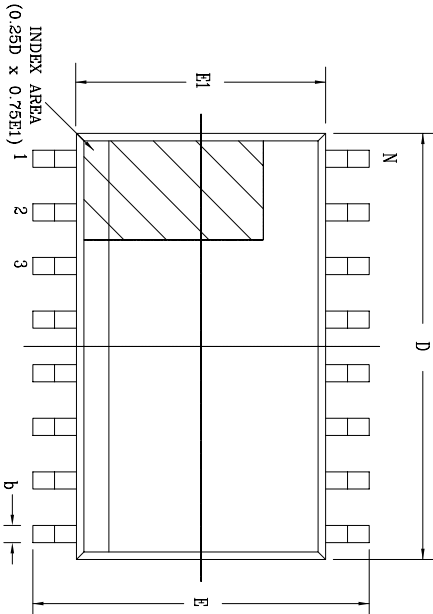
| 16 Pin SOICN | | JEDEC MS-012 | | Variation AC | | |
|--------------|------------------------------------|--------------|------|--|-------|-------|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | | DIMENSIONS IN INCH (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 1.35 | — | 1.75 | 0.053 | — | 0.069 |
| A1 | 0.10 | — | 0.25 | 0.004 | — | 0.010 |
| A2 | 1.25 | — | 1.65 | 0.049 | — | 0.065 |
| b | 0.31 | — | 0.51 | 0.012 | — | 0.020 |
| c | 0.17 | — | 0.25 | 0.007 | — | 0.010 |
| E | 6.00 | BSC | — | 0.236 | BSC | — |
| E1 | 3.90 | BSC | — | 0.154 | BSC | — |
| e | 1.27 | BSC | — | 0.050 | BSC | — |
| h | 0.25 | — | 0.50 | 0.010 | — | 0.020 |
| L | 0.40 | — | 1.27 | 0.016 | — | 0.050 |
| L1 | — | 1.04 | REF | — | 0.041 | REF |
| L2 | — | 0.25 | BSC | — | 0.010 | BSC |
| R | 0.07 | — | — | 0.003 | — | — |
| R1 | 0.07 | — | — | 0.003 | — | — |
| θ | 0° | — | 8° | 0° | — | 8° |
| θ1 | 5° | — | 15° | 5° | — | 15° |
| θ2 | 0° | — | — | 0° | — | — |
| D | 9.90 | BSC | — | 0.390 | BSC | — |
| N | 16 | — | — | 16 | — | — |

SIPEX CORPORATION

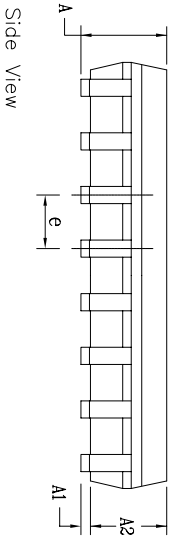
Solved by
Sipex

Packaging Approvals:
By: JL Date: 07/19/06

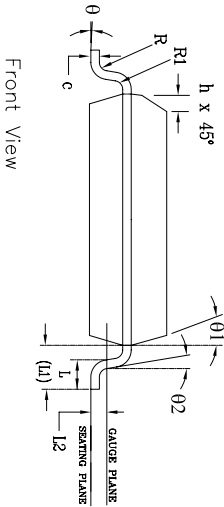
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Revision: B Sheet: 1 OF 1



Top View




Side View

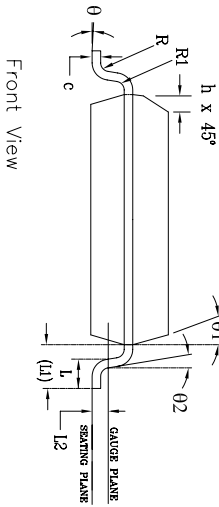
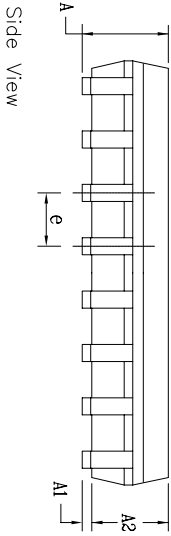
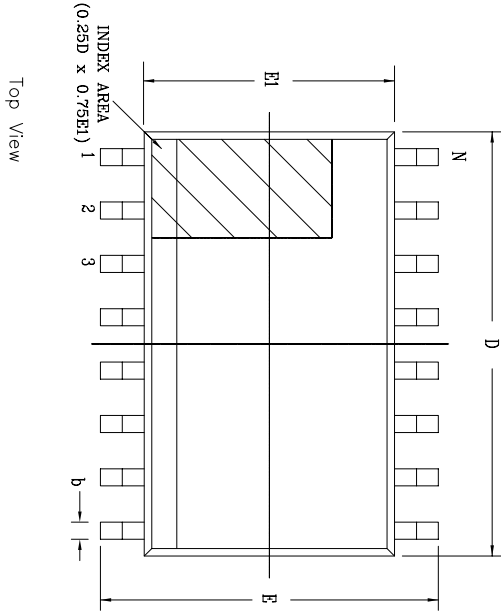


Front View

| 16 Pin SOICW | | JEDEC MS-013 | | Variation AA | | |
|--------------|------------------------------------|--------------|------|--|-----|-------|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | | DIMENSIONS IN INCH (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 2.35 | — | 2.65 | 0.093 | — | 0.104 |
| A1 | 0.10 | — | 0.30 | 0.004 | — | 0.012 |
| A2 | 2.05 | — | 2.55 | 0.081 | — | 0.100 |
| b | 0.31 | — | 0.51 | 0.012 | — | 0.020 |
| c | 0.20 | — | 0.33 | 0.008 | — | 0.013 |
| E | 10.30 BSC | | | 0.406 BSC | | |
| E1 | 7.50 BSC | | | 0.295 BSC | | |
| e | 0.25 | — | 0.75 | 0.010 | — | 0.030 |
| h | 0.40 | — | 1.27 | 0.016 | — | 0.050 |
| L | 1.40 REF | | | 0.055 REF | | |
| L1 | 0.25 BSC | | | 0.010 BSC | | |
| L2 | 0.07 | — | — | 0.003 | — | — |
| R | 0.07 | — | — | 0.003 | — | — |
| R1 | 0.07 | — | — | 0.003 | — | — |
| theta | 0° | — | 8° | 0° | — | 8° |
| theta1 | 5° | — | 15° | 5° | — | 15° |
| theta2 | 0° | — | — | 0° | — | — |
| D | 10.30 BSC | | | 0.405 BSC | | |
| N | 16 | | | 16 | | |


| REVISION HISTORY | | | |
|------------------|-----------------------------|----------|-------|
| REV. | DESCRIPTION | DATE | APP'D |
| A | DRAWING ORIENTATION | 11/05/05 | JL |
| B | DRAWING FORMAT MODIFICATION | 09/13/06 | JL |

| | | | |
|---|----------------|-------------------|---------------|
|  | | SIPEX CORPORATION | |
| | | | |
| Packaging Approval: | | Drawing No: | |
| By: JL | Date: 09/13/06 | Revision: B | Sheet: 1 OF 1 |



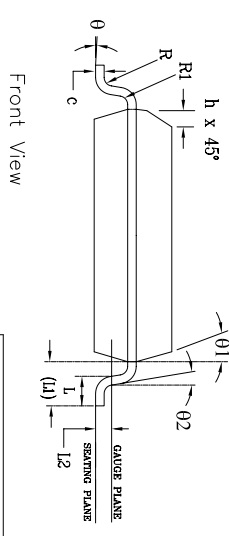
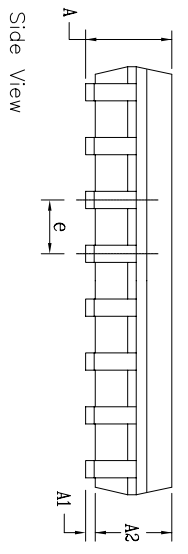
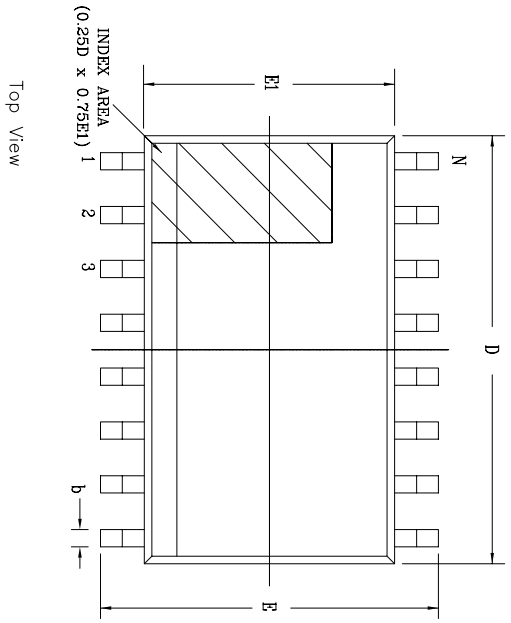
| 18 Pin SOICW | | JEDEC MS-013 | | Variation AB | | |
|--------------|------------------------------------|--------------|------|--|-----|-------|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | | DIMENSIONS IN INCH (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 2.35 | — | 2.65 | 0.093 | — | 0.104 |
| A1 | 0.10 | — | 0.30 | 0.004 | — | 0.012 |
| A2 | 2.05 | — | 2.55 | 0.081 | — | 0.100 |
| b | 0.31 | — | 0.51 | 0.012 | — | 0.020 |
| c | 0.20 | — | 0.33 | 0.008 | — | 0.013 |
| E | 10.30 BSC | | | 0.406 BSC | | |
| E1 | 7.50 BSC | | | 0.295 BSC | | |
| e | 1.27 BSC | | | 0.050 BSC | | |
| h | 0.25 | — | 0.75 | 0.010 | — | 0.030 |
| L | 0.40 | — | 1.27 | 0.016 | — | 0.050 |
| L1 | 1.40 REF | | | 0.055 REF | | |
| L2 | 0.25 BSC | | | 0.010 BSC | | |
| R | 0.07 | — | — | 0.003 | — | — |
| R1 | 0.07 | — | — | 0.003 | — | — |
| θ | 0° | — | 8° | 0° | — | 8° |
| θ1 | 5° | — | 15° | 5° | — | 15° |
| θ2 | 0° | — | — | 0° | — | — |
| D | 11.55 BSC | | | 0.455 BSC | | |
| N | 18 | | | 18 | | |


| REVISION HISTORY | | | |
|------------------|---------------------|----------|-------|
| REV. | DESCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATION | 04/24/06 | JL |

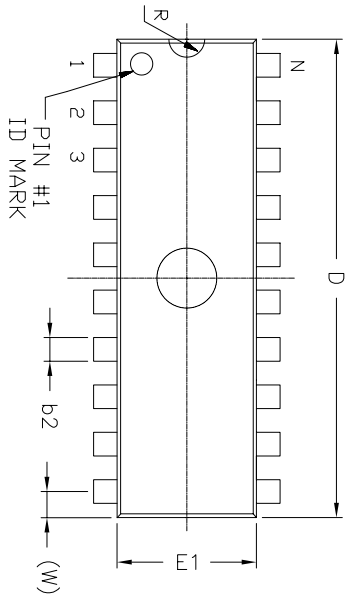
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|---|----------------|--------------------------|---------------|
|  | | SIPEX CORPORATION | |
| | | | |
| Packaging Approval: | | Drawing No: | |
| By: JL | Date: 04/24/06 | Revision: A | Sheet: 1 OF 1 |

| REVISION HISTORY | | | |
|------------------|---------------------|----------|-------|
| REV. | DESCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATION | 04/24/06 | JL |

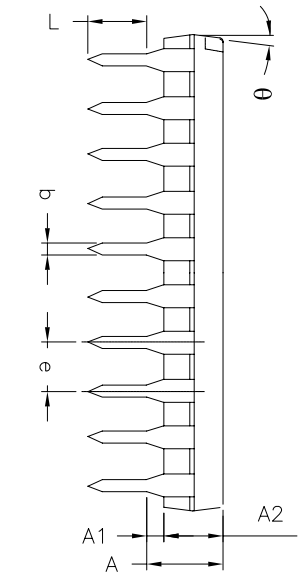
| 20 Pin SOICW | | JEDEC MS-013 | | Variation AC | |
|--------------|------------------------------------|--------------|--|--------------|-----|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | DIMENSIONS IN INCH (Reference Unit) | | MAX |
| | MIN. | NOM. | MIN. | NOM. | |
| A | 2.35 | — | 2.65 | 0.093 | — |
| A1 | 0.10 | — | 0.30 | 0.004 | — |
| A2 | 2.05 | — | 2.55 | 0.081 | — |
| b | 0.31 | — | 0.51 | 0.012 | — |
| c | 0.20 | — | 0.33 | 0.008 | — |
| E | 10.30 BSC | | 0.406 BSC | | — |
| E1 | 7.50 BSC | | 0.295 BSC | | — |
| e | 0.25 | — | 0.75 | 0.010 | — |
| h | 0.40 | — | 1.27 | 0.016 | — |
| L | 1.40 REF | | 0.055 REF | | — |
| L1 | 0.25 BSC | | 0.010 BSC | | — |
| L2 | 0.07 | — | 0.003 | — | — |
| R | 0.07 | — | 0.003 | — | — |
| R1 | 0° | — | 8° | 0° | — |
| θ | 5° | — | 15° | 5° | — |
| θ2 | 0° | — | 0° | — | — |
| D | 12.80 BSC | | 0.504 BSC | | — |
| N | 20 | | 20 | | — |



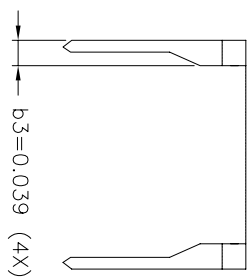
| | | | |
|---|----------------|---------------------------|--------|
|  | | SIPLEX CORPORATION | |
| | | | |
| Packaging Approval: | Drawing No: | Revision: | Sheet: |
| By: JL | Date: 04/24/06 | A | 1 OF 1 |



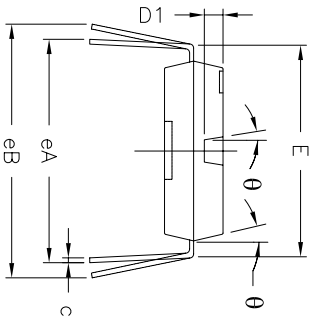
Top View



Side View



REMARKS:
FOR 8LD AND 16LD
ALL END LEADS (4X)
ARE HALF LEAD TYPES



Front View

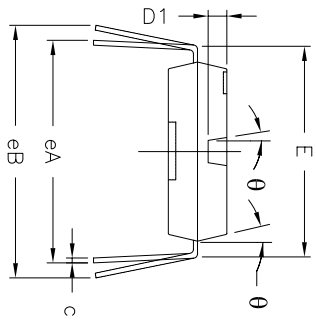
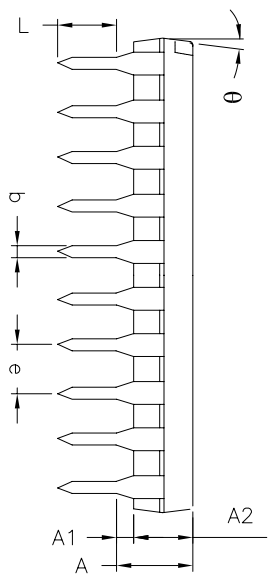
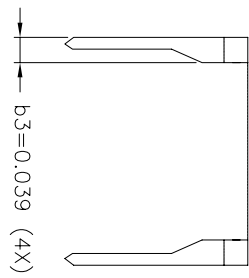
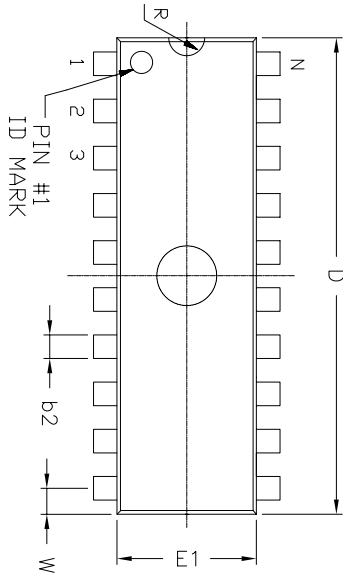
| REVISION HISTORY | | | |
|------------------|-----------------------------|----------|-------|
| REV | DESCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATOR | 11/21/05 | JL |
| B | DRAWING FORMAT MODIFICATION | 04/26/06 | JL |

| SYMBOLS | DIMENSIONS IN INCH (Control Unit) | | | DIMENSIONS IN MM (Reference Unit) | | |
|---------|--------------------------------------|-------|-------|--------------------------------------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | — | — | 0.210 | — | — | 5.33 |
| A1 | 0.015 | — | — | 0.38 | — | — |
| A2 | 0.115 | 0.130 | 0.195 | 2.92 | 3.30 | 4.95 |
| b | 0.014 | 0.018 | 0.022 | 0.36 | 0.46 | 0.56 |
| b2 | 0.045 | 0.060 | 0.070 | 1.14 | 1.52 | 1.78 |
| c | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D1 | 0.030 | — | 0.060 | 0.76 | — | 1.52 |
| E | 0.300 | 0.310 | 0.325 | 7.62 | 7.87 | 8.26 |
| E1 | 0.240 | 0.250 | 0.280 | 6.10 | 6.35 | 7.11 |
| e | 0.100 | BSC | — | 2.54 | BSC | — |
| eA | 0.300 | BSC | — | 7.62 | BSC | — |
| eB | — | — | 0.430 | — | — | 10.92 |
| L | 0.115 | 0.130 | 0.150 | 2.92 | 3.30 | 3.81 |
| W | 0.075 | REF | — | 1.91 | REF | — |
| R | 0.030 | BSC | — | 0.76 | BSC | — |
| theta | 4° | 7° | 10° | 4° | 7° | 10° |
| D | 0.735 | 0.755 | 0.775 | 18.67 | 19.18 | 19.69 |
| N | — | 16 | — | — | 16 | — |

SIPLEX CORPORATION
Solved By
Sipex

Packaging Approval: 16 PIN PDIP PACKAGE OUTLINE
 Drawing No: 16-PIN PDIP
 By: JL Date: 04/26/06 Revisions: B Sheet: 1 Of 1

REMARKS:
FOR 8LD AND 16LD
ALL END LEADS (4X)
ARE HALF LEAD TYPES



Side View

Front View

| 18 Pin PDIP JEDEC MS-001 Variation A/C | | | | | | |
|--|--------------------------------------|-------|-------|--------------------------------------|-------|-------|
| SYMBOLS | DIMENSIONS IN INCH (Control Unit) | | | DIMENSIONS IN MM (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | — | — | 0.210 | — | — | 5.33 |
| A1 | 0.015 | — | — | 0.38 | — | — |
| A2 | 0.115 | 0.130 | 0.195 | 2.92 | 3.30 | 4.95 |
| b | 0.014 | 0.018 | 0.022 | 0.36 | 0.46 | 0.56 |
| b2 | 0.045 | 0.060 | 0.070 | 1.14 | 1.52 | 1.78 |
| c | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 |
| D1 | 0.030 | — | 0.060 | 0.76 | — | 1.52 |
| E | 0.300 | 0.310 | 0.325 | 7.62 | 7.87 | 8.26 |
| E1 | 0.240 | 0.250 | 0.280 | 6.10 | 6.35 | 7.11 |
| e | — | 0.100 | BSC | — | 2.54 | BSC |
| eA | — | 0.300 | BSC | — | 7.62 | BSC |
| eB | — | — | 0.430 | — | — | 10.92 |
| L | 0.115 | 0.130 | 0.150 | 2.92 | 3.30 | 3.81 |
| W | — | 0.075 | REF | — | 1.91 | REF |
| R | — | 0.030 | BSC | — | 0.76 | BSC |
| theta | 4° | 7° | 10° | 4° | 7° | 10° |
| D | 0.880 | 0.900 | 0.920 | 22.35 | 22.86 | 23.37 |
| N | 18 | | | 18 | | |

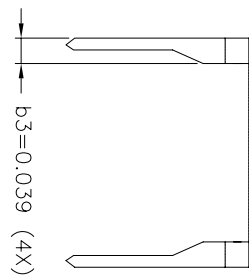
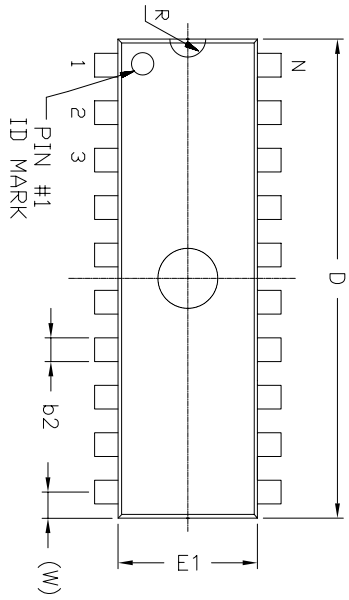
| REVISION HISTORY | | | |
|------------------|--------------------|----------|-------|
| REV. | DESCRIPTION | DATE | APP'D |
| A | DRAWING ORIGINATOR | 04/26/06 | JL |

SIPEX CORPORATION

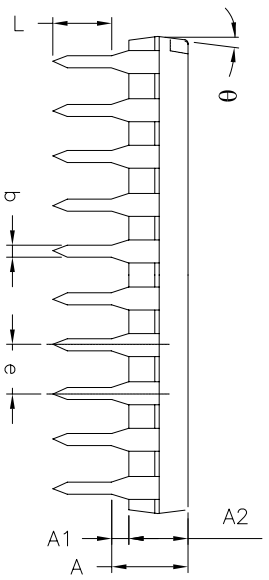
18 PIN PDIP PACKAGE OUTLINE

| | | | |
|--------|----------------|-------------|---------------|
| By: JL | Date: 04/26/06 | Revision: A | Sheet: 1 OF 1 |
|--------|----------------|-------------|---------------|

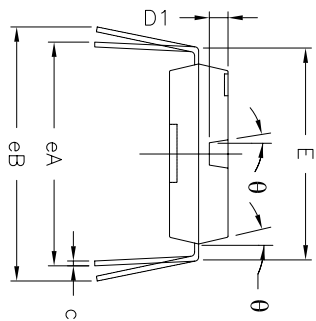
REMARKS:
 FOR 8LD AND 16LD
 ALL END LEADS (4X)
 ARE HALF LEAD TYPES



Top View




Side View



Front View

| REVISION HISTORY | | DATE | APP'D |
|------------------|---------------------|----------|-------|
| REV. | DISCRIPTION | 04/26/06 | JL |
| A | DRAWING ORIGINATION | | |

| 20 Pin PDIP JEDEC MS-001 Variation AD | | | | | | | | | |
|---------------------------------------|-----------------------------------|-------|-------|-----------------------------------|-------|-------|------|--|--|
| SYMBOLS | DIMENSIONS IN INCH (Control Unit) | | | DIMENSIONS IN MM (Reference Unit) | | | | | |
| | MIN | NOM | MAX | MIN | NOM | MAX | | | |
| A | — | — | 0.210 | — | — | — | 5.33 | | |
| A1 | 0.015 | — | — | 0.38 | — | — | | | |
| A2 | 0.115 | 0.130 | 0.195 | 2.92 | 3.30 | 4.95 | | | |
| b | 0.014 | 0.018 | 0.022 | 0.36 | 0.46 | 0.56 | | | |
| b2 | 0.045 | 0.060 | 0.070 | 1.14 | 1.52 | 1.78 | | | |
| c | 0.008 | 0.010 | 0.014 | 0.20 | 0.25 | 0.36 | | | |
| D1 | 0.030 | — | 0.060 | 0.76 | — | 1.52 | | | |
| E | 0.300 | 0.310 | 0.325 | 7.62 | 7.87 | 8.26 | | | |
| E1 | 0.240 | 0.250 | 0.280 | 6.10 | 6.35 | 7.11 | | | |
| e | 0.100 | BSC | | 2.54 | BSC | | | | |
| eA | 0.300 | BSC | | 7.62 | BSC | | | | |
| eB | — | — | 0.430 | — | — | 10.92 | | | |
| L | 0.115 | 0.130 | 0.150 | 2.92 | 3.30 | 3.81 | | | |
| W | 0.075 | REF | | 1.91 | REF | | | | |
| R | 0.030 | BSC | | 0.76 | BSC | | | | |
| theta | 4° | 7° | 10° | 4° | 7° | 10° | | | |
| D | 0.980 | 1.030 | 1.060 | 24.89 | 26.16 | 26.92 | | | |
| N | 20 | | | 20 | | | | | |

| | | | |
|---|--|--|--|
|  | | SIPLEX CORPORATION 20 PIN PDIP PACKAGE OUTLINE | |
| | | | |

ORDERING INFORMATION

| Part Number | Temperature Range | Topmark | Package |
|------------------|---------------------|---------------|--------------|
| SP232ACN..... | 0°C to +70°C..... | SP232ACN..... | 16-pin NSOIC |
| SP232ACN/TR..... | 0°C to +70°C..... | SP232ACN..... | 16-pin NSOIC |
| SP232ACP..... | 0°C to +70°C..... | SP232ACP..... | 16-pin PDIP |
| SP232ACT..... | 0°C to +70°C..... | SP232ACT..... | 16-pin WSOIC |
| SP232ACT/TR..... | 0°C to +70°C..... | SP232ACT..... | 16-pin WSOIC |
| SP232AEN..... | -40°C to +85°C..... | SP232AEN..... | 16-pin NSOIC |
| SP232AEN/TR..... | -40°C to +85°C..... | SP232AEN..... | 16-pin NSOIC |
| SP232AEP..... | -40°C to +85°C..... | SP232AEP..... | 16-pin PDIP |
| SP232AET..... | -40°C to +85°C..... | SP232AET..... | 16-pin WSOIC |
| SP232AET/TR..... | -40°C to +85°C..... | SP232AET..... | 16-pin WSOIC |
| | | | |
| SP233ACP..... | 0°C to +70°C..... | SP233ACP..... | 20-pin PDIP |
| SP233ACT..... | 0°C to +70°C..... | SP233ACT..... | 20-pin WSOIC |
| SP233ACT/TR..... | 0°C to +70°C..... | SP233ACT..... | 20-pin WSOIC |
| SP233AEP..... | -40°C to +85°C..... | SP233AEP..... | 20-pin PDIP |
| SP233AET..... | -40°C to +85°C..... | SP233AET..... | 20-pin WSOIC |
| SP233AET/TR..... | -40°C to +85°C..... | SP233AET..... | 20-pin WSOIC |
| | | | |
| SP310ACP..... | 0°C to +70°C..... | SP310ACP..... | 18-pin PDIP |
| SP310ACT..... | 0°C to +70°C..... | SP310ACT..... | 18-pin WSOIC |
| SP310ACT/TR..... | 0°C to +70°C..... | SP310ACT..... | 18-pin WSOIC |
| SP310AEP..... | -40°C to +85°C..... | SP310AEP..... | 18-pin PDIP |
| SP310AET..... | -40°C to +85°C..... | SP310AET..... | 18-pin WSOIC |
| SP310AET/TR..... | -40°C to +85°C..... | SP310AET..... | 18-pin WSOIC |
| | | | |
| SP312ACP..... | 0°C to +70°C..... | SP312ACP..... | 18-pin PDIP |
| SP312ACT..... | 0°C to +70°C..... | SP312ACT..... | 18-pin WSOIC |
| SP312ACT/TR..... | 0°C to +70°C..... | SP312ACT..... | 18-pin WSOIC |
| SP312AEP..... | -40°C to +85°C..... | SP312AEP..... | 18-pin PDIP |
| SP312AET..... | -40°C to +85°C..... | SP312AET..... | 18-pin WSOIC |
| SP312AET/TR..... | -40°C to +85°C..... | SP312AET..... | 18-pin WSOIC |

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.



Solved by Sipex™

Sipex Corporation

**Headquarters and
Sales Office**

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Milpitas, CA 95035
TEL: (408) 934-7500
FAX: (408) 935-7600

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