High Speed Intelligent +3.0V to +5.5V RS-232 Transceivers

- Meets true EIA/TIA-232-F Standards from a +3.0V to +5.5V power supply
- Interoperable with EIA/TIA-232 and adheres to EIA/TIA-562 down to a +2.7V power source
- ***Auto-Online***™ circuitry automatically wakes up from a 1μA shutdown
- Regulated Charge Pump Yields Stable RS-232 Outputs Regardless of V_{CC} Variations
- ESD Specifications: ±2kV Human Body Model
- 460 Kbps minimum transmission rate
- Ideal for High Speed RS-232 Applications

DESCRIPTION

The **SP3223H** and **3243H** products are RS-232 transceiver solutions intended for portable or hand-held applications such as notebook and palmtop computers. The "H" series is based on **Sipex's SP3223/3243** series and has been enhanced for high speed. The data rate is improved to 460Kbps, easily meeting the demands of high speed RS-232 applications. The **SP3223H** and **3243H** use an internal high-efficiency, charge-pump power supply that requires only 0.1μF capacitors in 3.3V operation. This charge pump and **Sipex's** driver architecture allow the **SP3223H/3243H** series to deliver compliant RS-232 performance from a single power supply ranging from +3.3V to +5.0V. The **SP3223H** is a 2-driver/2-receiver device, and the **SP3243H** is a 3-driver/5-receiver device, ideal for laptop/notebook computer and PDA applications. The **SP3243H** includes one complementary receiver that remains alert to monitor an external device's Ring Indicate signal while the device is shutdown.

The ***Auto-Online*** feature allows the device to automatically "wake-up" during a shutdown state when an RS-232 cable is connected and a connected peripheral is turned on. Otherwise, the device automatically shuts itself down drawing less than 1μA.

SELECTION TABLE

Device	Power Supplies	RS-232 Drivers	RS-232 Receivers	External Components	*Auto-Online* Circuitry	TTL 3-State	No. of Pins
SP3223H	+3.0V to +5.5V	2	2	4 capacitors	YES	YES	20
SP3243H	+3.0V to +5.5V	3	5	4 capacitors	YES	YES	28

Applicable U.S. Patents - 5,306,954; and other patents pending.

ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability and cause permanent damage to the device.

V_{CC}.....-0.3V to +6.0V
V+ (NOTE 1).....-0.3V to +7.0V
V- (NOTE 1).....+0.3V to -7.0V
V+ + |V-| (NOTE 1).....+13V
I_{CC} (DC V_{CC} or GND current).....±100mA

Input Voltages

TxIN, $\overline{\text{ONLINE}}$,
SHUTDOWN, EN (**SP3223H**).....-0.3V to +6.0V
RxIN.....±15V

Output Voltages

TxOUT.....±15V
RxOUT, STATUS.....-0.3V to (V_{CC} + 0.3V)

Short-Circuit Duration

TxOUT.....Continuous
Storage Temperature.....-65°C to +150°C

Power Dissipation per package

20-pin PDIP (derate 16.0mW/°C above+70°C).....1300mW
20-pin SSOP (derate 9.25mW/°C above +70°C)....750mW
20-pin TSSOP (derate 11.1mW/°C above +70°C)..900mW
28-pin SOIC (derate 12.7mW/°C above +70°C)....1000mW
28-pin SSOP (derate 11.2mW/°C above +70°C).....900mW

NOTE 1: V+ and V- can have maximum magnitudes of 7V, but their absolute difference cannot exceed 13V.

SPECIFICATIONS

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V with T_{AMB} = T_{MIN} to T_{MAX}. Typical values apply at V_{CC} = +3.3V or +5.0V and T_{AMB} = 25°C.

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
DC CHARACTERISTICS					
Supply Current, *Auto-Online*		1.0	10	µA	All RxIN open, $\overline{\text{ONLINE}}$ = GND, SHUTDOWN = V_{CC}, V_{CC} = +3.3V, T_{AMB} = +25° C
Supply Current, Shutdown		1.0	10	µA	$\overline{\text{SHUTDOWN}}$ = GND, V_{CC} = +3.3V, T_{AMB} = +25° C
Supply Current, *Auto-Online* Disabled		0.3	1.0	mA	$\overline{\text{ONLINE}}$ = $\overline{\text{SHUTDOWN}}$ = V_{CC}, no load, V_{CC} = +3.3V, T_{AMB} = +25° C
LOGIC INPUTS AND RECEIVER OUTPUTS					
Input Logic Threshold LOW HIGH	 2.0		 0.8	 V	V_{CC} = +3.3V or +5.0V, TxIN, $\overline{\text{EN}}$ (**SP3223H**), $\overline{\text{ONLINE}}$, $\overline{\text{SHUTDOWN}}$
Input Leakage Current		±0.01	±1.0	µA	TxIN, $\overline{\text{EN}}$, $\overline{\text{ONLINE}}$, $\overline{\text{SHUTDOWN}}$, T_{AMB} = +25° C
Output Leakage Current		±0.05	±10	µA	Receivers disabled
Output Voltage LOW			0.4	V	I_{OUT} = 1.6mA
Output Voltage HIGH	V_{CC} - 0.6	V_{CC} - 0.1		V	I_{OUT} = -1.0mA

SPECIFICATIONS (continued)

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V with $T_{AMB} = T_{MIN}$ to T_{MAX}. Typical values apply at V_{CC} = +3.3V or +5.0V and T_{AMB} = 25°C.

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
DRIVER OUTPUTS					
Output Voltage Swing	±5.0	±5.4		V	All driver outputs loaded with 3KΩ to GND, T_{AMB} = +25° C
Output Resistance	300			Ω	V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V
Output Short-Circuit Current		±35 ±70	±60 ±100	mA	V_{OUT} = 0V V_{OUT} = ±15V
Output Leakage Current			±25	µA	V_{CC} = 0V or 3.0V to 5.5V, V_{OUT} = ±12V, Drivers disabled
RECEIVER INPUTS					
Input Voltage Range	-15		15	V	
Input Threshold LOW	0.6	1.2		V	V_{CC} = 3.3V
Input Threshold LOW	0.8	1.5		V	V_{CC} = 5.0V
Input Threshold HIGH		1.5	2.4	V	V_{CC} = 3.3V
Input Threshold HIGH		1.8	2.4	V	V_{CC} = 5.0V
Input Hysteresis		0.3		V	
Input Resistance	3	5	7	kΩ	
Auto-Online **CIRCUITRY CHARACTERISTICS ($\overline{\text{ONLINE}}$ = GND, $\overline{\text{SHUTDOWN}}$ = V_{CC})**					
$\overline{\text{STATUS}}$ Output Voltage LOW			0.4	V	I_{OUT} = 1.6mA
$\overline{\text{STATUS}}$ Output Voltage HIGH	V_{CC} - 0.6			V	I_{OUT} = -1.0mA
Receiver Threshold to Drivers Enabled (t_{ONLINE})		200		µS	Figure 15
Receiver Positive or Negative Threshold to $\overline{\text{STATUS}}$ HIGH (t_{STSH})		0.5		µS	Figure 15
Receiver Positive or Negative Threshold to $\overline{\text{STATUS}}$ LOW (t_{STSL})		20		µS	Figure 15

SPECIFICATIONS (continued)

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V with $T_{AMB} = T_{MIN}$ to T_{MAX}. Typical values apply at V_{CC} = +3.3V or +5.0V and T_{AMB} = 25°C.

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
TIMING CHARACTERISTICS					
Maximum Data Rate	460			Kbps	R_L = 3KΩ, C_L = 1000pF, one driver active
Receiver Propagation Delay t_{PHL} t_{PLH}		 0.3 0.3		µs	Receiver input to Receiver output, C_L = 150pF
Receiver Output Enable Time		200		ns	Normal operation
Receiver Output Disable Time		200		ns	Normal operation
Driver Skew		50	100	ns	$\lvert t_{PHL} - t_{PLH} \rvert$
Receiver Skew		200	1000	ns	$\lvert t_{PHL} - t_{PLH} \rvert$
Transition-Region Slew Rate		60		V/µs	V_{CC}= 3.3V, R_L = 3KΩ, T_{AMB} = 25°C, measurements taken from -3.0V to +3.0V or +3.0V to -3.0V

TYPICAL PERFORMANCE CHARACTERISTICS

Unless otherwise noted, the following performance characteristics apply for V_{CC} = +3.3V, 235Kbps data rate, all drivers loaded with 3kΩ, 0.1µF charge pump capacitors, and T_{AMB} = +25°C.

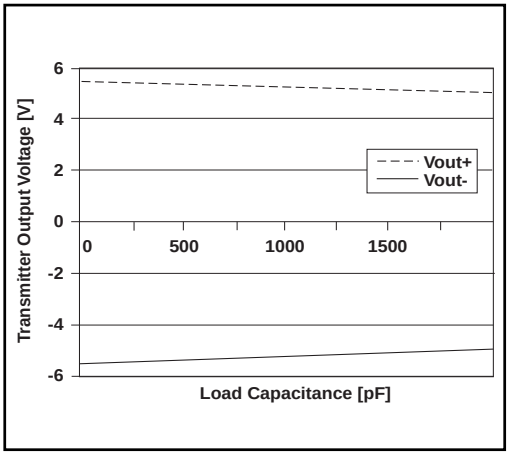


Figure 1. Transmitter Output Voltage VS. Load Capacitance for the SP3223H

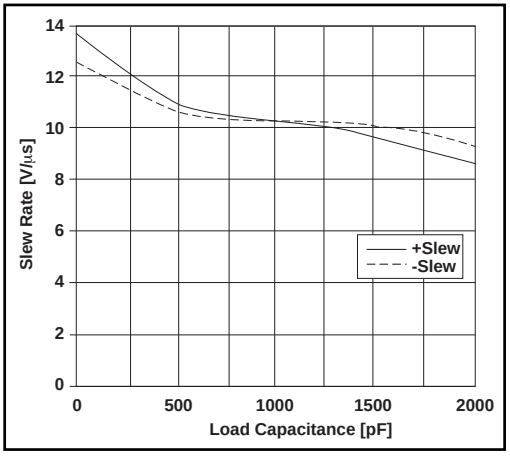


Figure 2. Slew Rate VS. Load Capacitance for the SP3223H

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

Unless otherwise noted, the following performance characteristics apply for V_{CC} = +3.3V, 235Kbps data rate, all drivers loaded with 3kΩ, 0.1µF charge pump capacitors, and T_{AMB} = +25°C.

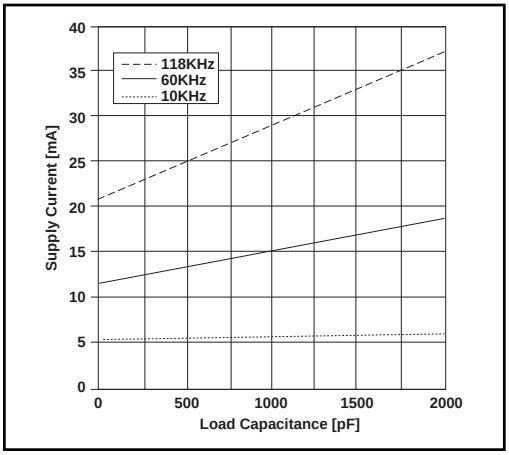


Figure 3. Supply Current VS. Load Capacitance when Transmitting Data for the SP3223H

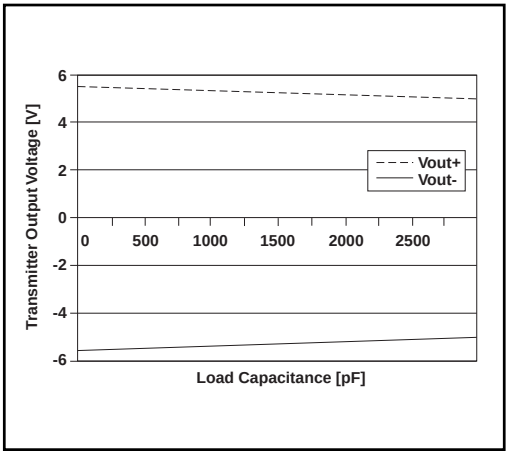


Figure 4. Transmitter Output Voltage VS. Load Capacitance for the SP3243H

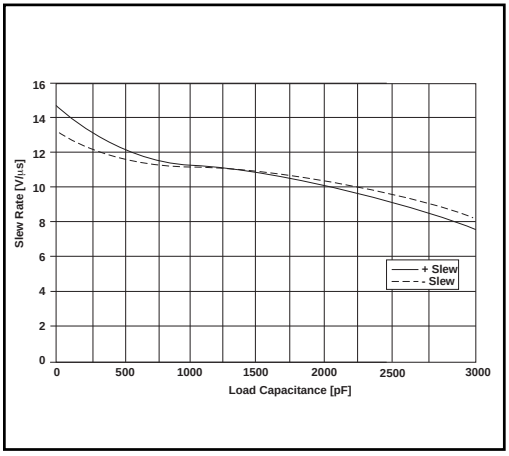


Figure 5. Slew Rate VS. Load Capacitance for the SP3243H

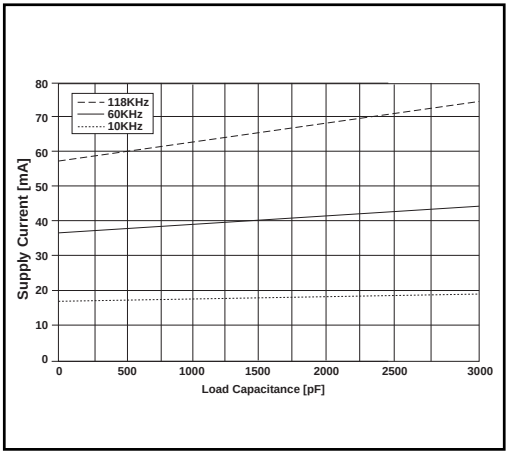


Figure 6. Supply Current VS. Load Capacitance when Transmitting Data for the SP3243H

NAME	FUNCTION	PIN NUMBER	
		SP3223H	SP3243H
$\overline{EN}$	Receiver Enable. Apply logic LOW for normal operation. Apply logic HIGH to disable the receiver outputs (high-Z state).	1	-
C1+	Positive terminal of the voltage doubler charge-pump capacitor.	2	28
V+	Regulated +5.5V output generated by the charge pump.	3	27
C1-	Negative terminal of the voltage doubler charge-pump capacitor.	4	24
C2+	Positive terminal of the inverting charge-pump capacitor.	5	1
C2-	Negative terminal of the inverting charge-pump capacitor.	6	2
V-	Regulated -5.5V output generated by the charge pump.	7	3
R_1IN	RS-232 receiver input.	16	4
R_2IN	RS-232 receiver input.	9	5
R_3IN	RS-232 receiver input.	-	6
R_4IN	RS-232 receiver input.	-	7
R_5IN	RS-232 receiver input.	-	8
R_1OUT	TTL/CMOS receiver output.	15	19
R_2OUT	TTL/CMOS receiver output.	10	18
$\overline{R_2OUT}$	Non-inverting receiver-2 output, active in shutdown.	-	20
R_3OUT	TTL/CMOS receiver output.	-	17
R_4OUT	TTL/CMOS receiver output.	-	16
R_5OUT	TTL/CMOS receiver output.	-	15
$\overline{STATUS}$	TTL/CMOS Output indicating online and shutdown status.	11	21
T_1IN	TTL/CMOS driver input.	13	14
T_2IN	TTL/CMOS driver input.	12	13
T_3IN	TTL/CMOS driver input.	-	12
$\overline{ONLINE}$	Apply logic HIGH to override *Auto-Online* circuitry keeping drivers active ($\overline{SHUTDOWN}$ must also be logic HIGH, refer to Table 2).	14	23
T_1OUT	RS-232 driver output.	17	9
T_2OUT	RS-232 driver output.	8	10
T_3OUT	RS-232 driver output.	-	11
GND	Ground.	18	25
V_{CC}	+3.0V to +5.5V supply voltage.	19	26
$\overline{SHUTDOWN}$	Apply logic LOW to shut down drivers and charge pump. This overrides all *Auto-Online* circuitry and $\overline{ONLINE}$ (refer to Table 2).	20	22

Table 1. Device Pin Description

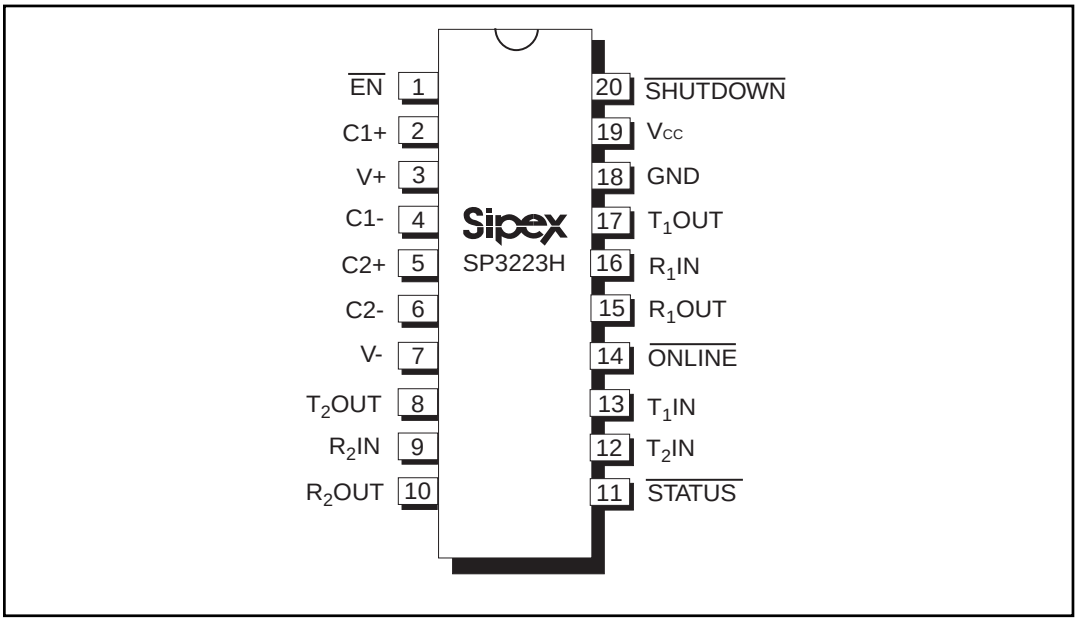


Figure 7. SP3223H Pinout Configuration

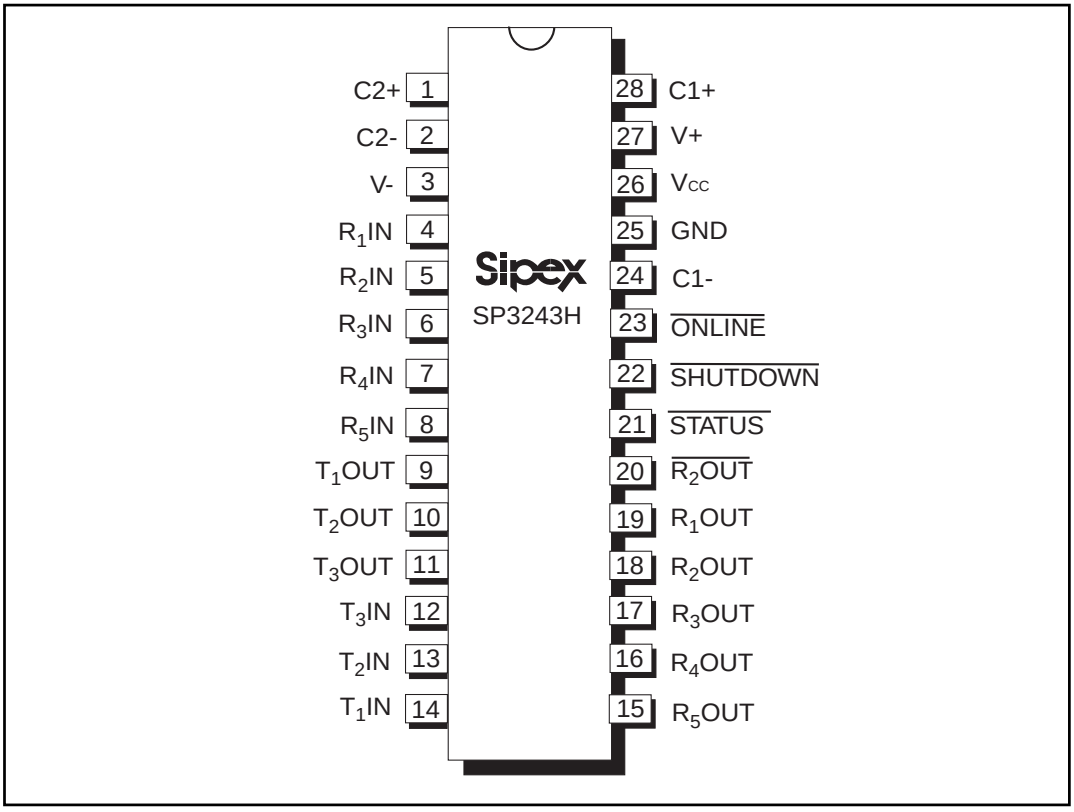


Figure 8. SP3243H Pinout Configuration

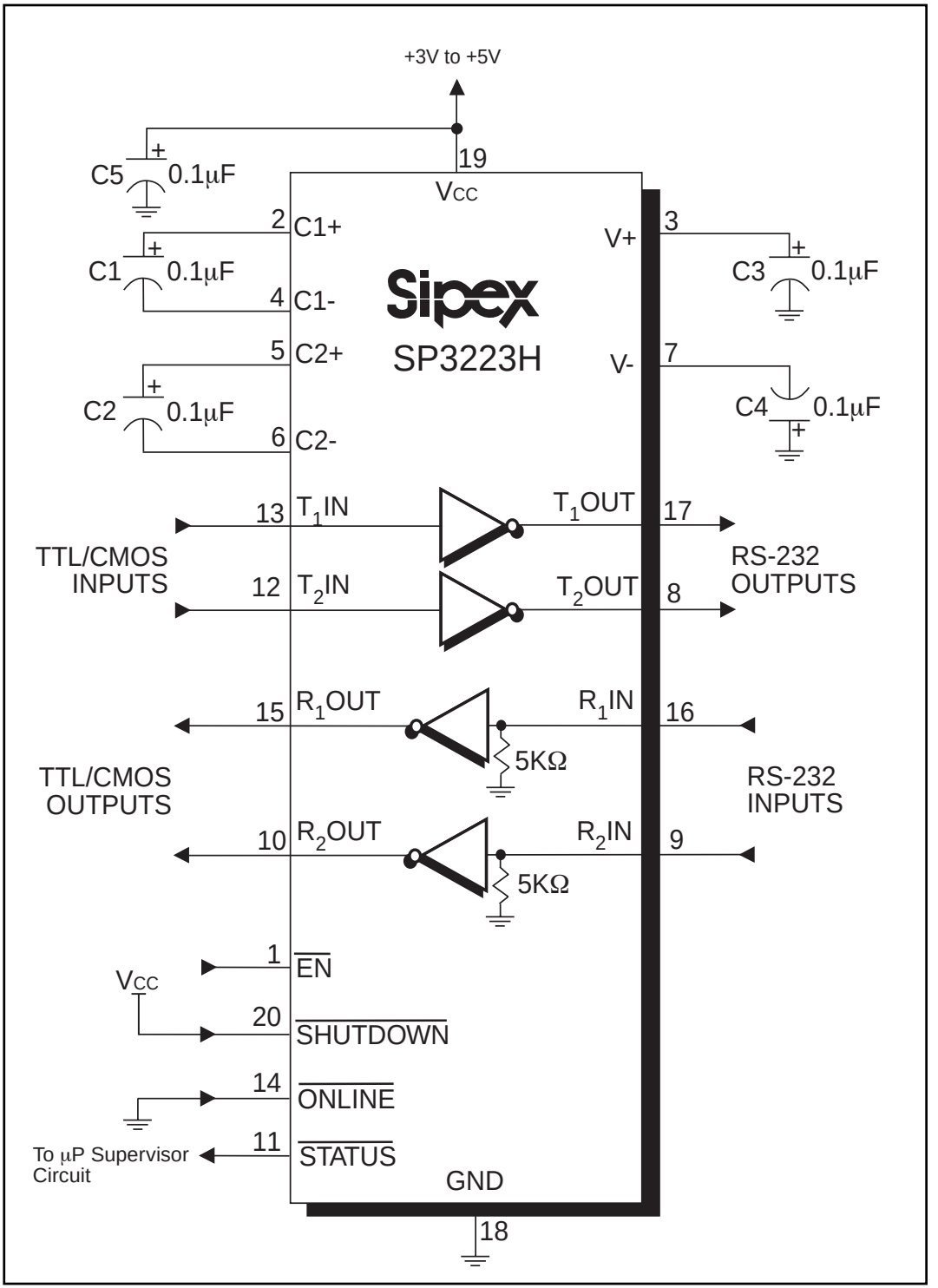


Figure 9. SP3223H Typical Operating Circuit

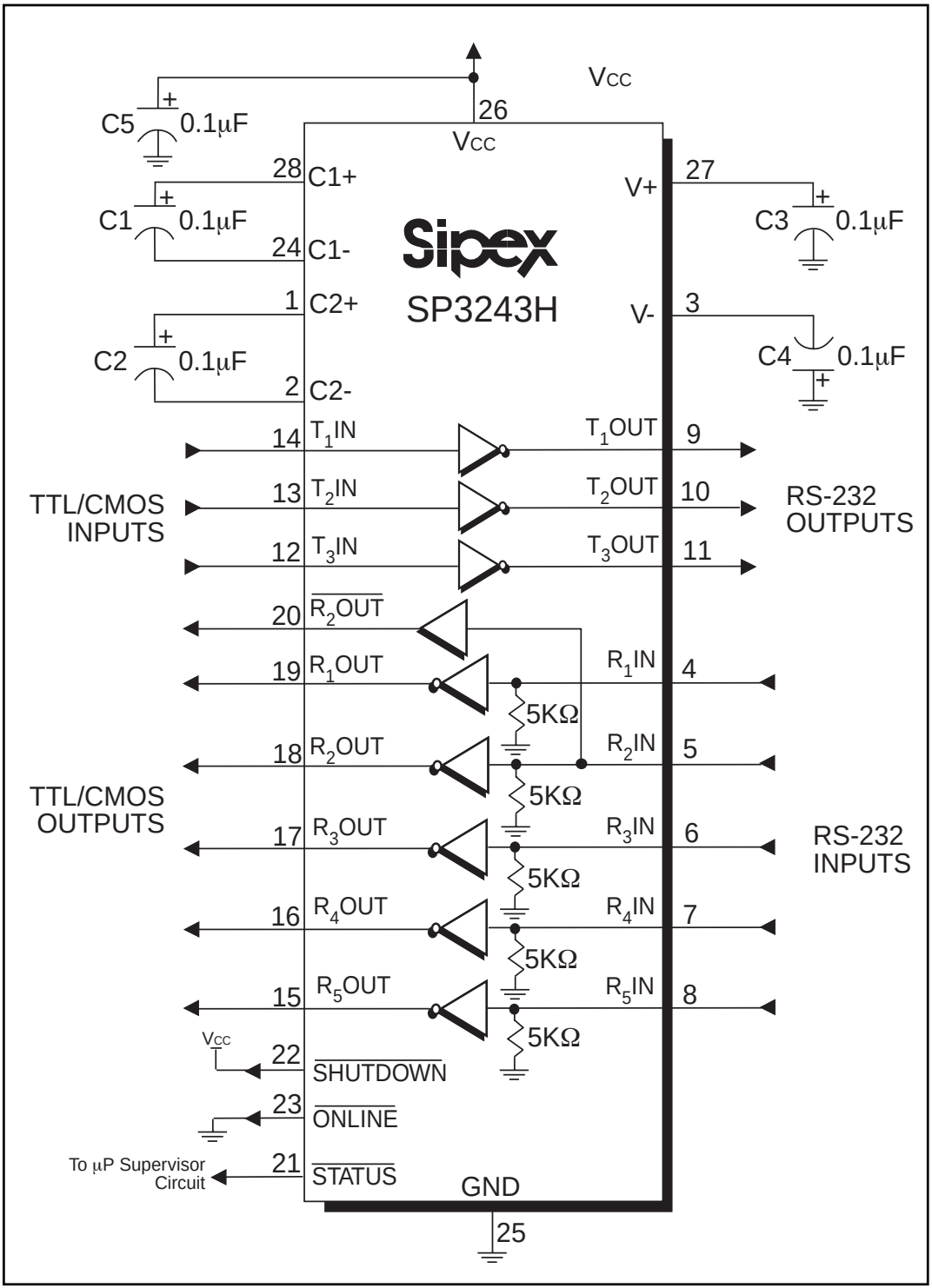


Figure 10. SP3243H Typical Operating Circuit

DESCRIPTION

The **SP3223H** and **SP3243H** transceivers meet the EIA/TIA-232 and ITU-T V.28/V.24 communication protocols and can be implemented in battery-powered, portable, or hand-held applications such as notebook or palmtop computers. The **SP3223H** and **SP3243H** devices feature **Sipex's** proprietary and patented (U.S.-- 5,306,954) on-board charge pump circuitry that generates ±5.5V RS-232 voltage levels from a single +3.0V to +5.5V power supply. The **SP3223H** and **SP3243H** devices can operate at a data rate of 460Kbps fully loaded.

The **SP3223H** is a 2-driver/2-receiver device, and the **SP3243H** is a 3-driver/5-receiver device, ideal for portable or hand-held applications. The **SP3243H** includes one complementary always-active receiver that can monitor an external device (such as a modem) in shutdown. This aids in protecting the UART or serial controller IC by preventing forward biasing of the protection diodes where V_{CC} may be disconnected.

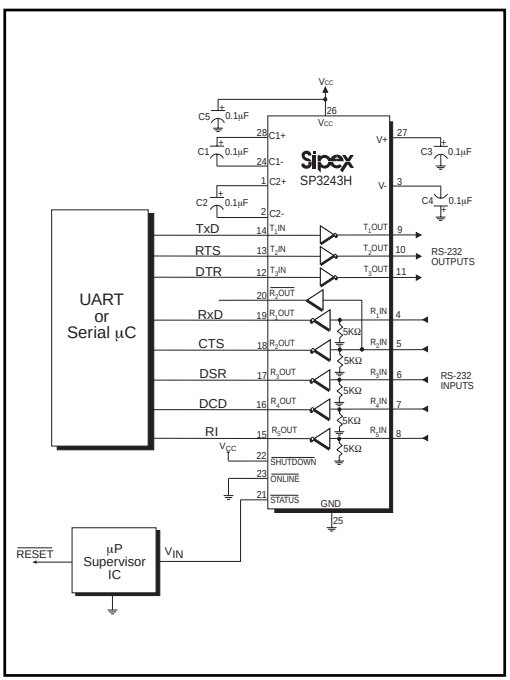


Figure 11. Interface Circuitry Controlled by Microprocessor Supervisory Circuit

The **SP3223H** and **SP3243H** series is an ideal choice for power sensitive designs. The **SP3223H** and **SP3243H** devices feature ***Auto-Online*** circuitry which reduces the power supply drain to a 1µA supply current. In many portable or hand-held applications, an RS-232 cable can be disconnected or a connected peripheral can be turned off. Under these conditions, the internal charge pump and the drivers will be shut down. Otherwise, the system automatically comes online. This feature allows design engineers to address power saving concerns without major design changes.

THEORY OF OPERATION

The **SP3223H** and **SP3243H** series is made up of four basic circuit blocks: 1. Drivers, 2. Receivers, 3. the Sipex proprietary charge pump, and 4. ***Auto-Online*** circuitry.

Drivers

The drivers are inverting level transmitters that convert TTL or CMOS logic levels to 5.0V EIA/TIA-232 levels with an inverted sense relative to the input logic levels. Typically, the RS-232 output voltage swing is ±5.4V with no load and ±5V minimum fully loaded. The driver outputs are protected against infinite short-circuits to ground without degradation in reliability. These drivers comply with the EIA-TIA-232-F and all previous RS-232 versions.

The drivers can guarantee a data rate over 460Kbps fully loaded with 3KΩ in parallel with 1000pF, ensuring compatibility with PC-to-PC communication software.

The slew rate of the driver output is internally limited to a maximum of 30V/µs in order to meet the EIA standards (EIA RS-232D 2.1.7, Paragraph 5). The transition of the loaded output from HIGH to LOW also meets the monotonicity requirements of the standard.

DEVICE: SP3223H			
$\overline{SHUTDOWN}$	$\overline{EN}$	T_XOUT	R_XOUT
0	0	High Z	Active
0	1	High Z	High Z
1	0	Active	Active
1	1	Active	High Z
DEVICE: SP3243H			
$\overline{SHUTDOWN}$	T_XOUT	R_XOUT	$\overline{R_2OUT}$
0	High Z	High Z	Active
1	Active	Active	Active

Table 2. $\overline{SHUTDOWN}$ and $\overline{EN}$ Truth Tables
Note: In Auto-Online Mode where $\overline{ONLINE}$ = GND and $\overline{SHUTDOWN}$ = V_{CC}, the device will shut down if there is no activity present at the Receiver inputs.

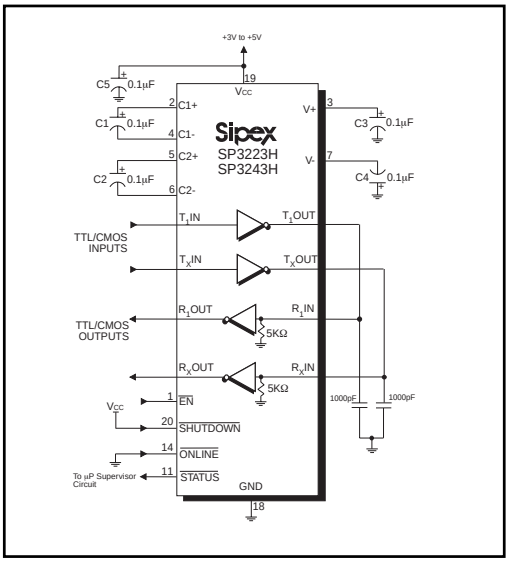


Figure 12. Loopback Test Circuit for RS-232 Driver Data Transmission Rates

The **SP3223H** and **SP3243H** drivers can maintain high data rates over 460Kbps fully loaded. *Figure 12* shows a loopback test circuit used to test the RS-232 Drivers. *Figure 13* shows the test results of the loopback circuit with all three drivers active at 120Kbps with typical RS-232 loads in parallel with 1000pF capacitors. *Figure 14* shows the test results where one driver was active at 1Mbps and all three drivers loaded with an RS-232 receiver in parallel with a 1000pF capacitor. A superior RS-232 data transmission rate of 1Mbps makes the **SP3223H/3243H** series an ideal match for high speed LAN and personal computer peripheral applications.

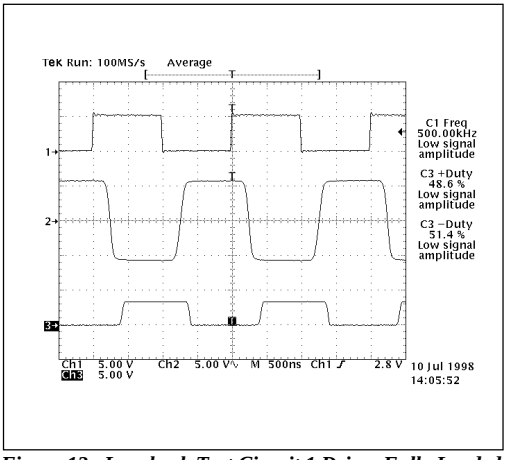


Figure 13. Loopback Test Circuit 1 Driver Fully Loaded

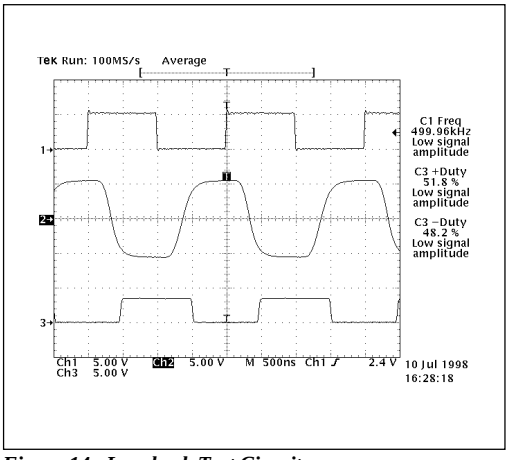


Figure 14. Loopback Test Circuit (All Drivers Fully Loaded)

Receivers

The receivers convert ±5.0V EIA/TIA-232 levels to TTL or CMOS logic output levels. All receivers have an inverting output that can be disabled by using the $\overline{EN}$ pin.

Receivers are active when the *Auto-Online*

circuitry is enabled or when in shutdown. During the shutdown, the receivers will continue to be active. If there is no activity present at the receivers for a period longer than 100µs or when SHUTDOWN is enabled, the device goes into a standby mode where the circuit draws 1µA. Driving EN to a logic HIGH forces the outputs of the receivers into high-impedance. The truth table logic of the **SP3223H** and **SP3243H** driver and receiver outputs can be found in *Table 2*.

The **SP3243H** includes an additional non-inverting receiver with an output R_2OUT. R_2OUT is an extra output that remains active and monitors activity while the other receiver outputs are forced into high impedance. This allows Ring Indicator (RI) from a peripheral to be monitored without forward biasing the TTL/CMOS inputs of the other devices connected to the receiver outputs.

Since receiver 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 300mV. This ensures that the receiver is virtually immune to noisy transmission lines. Should an input be left unconnected, an internal 5KΩ pulldown resistor to ground will commit the output of the receiver to a HIGH state.

Charge Pump

The charge pump is a **Sipex**–patented design (U.S. 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 5.5V power supplies. The internal power supply consists of a regulated dual charge pump that provides output voltages 5.5V regardless of the input voltage (V_{CC}) over the +3.0V to +5.5V range. This is important to maintain compliant RS-232 levels regardless of power supply fluctuations.

The charge pump operates in a discontinuous mode using an internal oscillator. If the output voltages are less than a magnitude of 5.5V, the charge pump is enabled. If the output voltages exceed a magnitude of 5.5V, the charge pump is disabled. This oscillator 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 V_{CC}. C_1^+ is then switched to GND and the charge in C_1^- is transferred to C_2^-. Since C_2^+ is connected to V_{CC}, the voltage potential across capacitor C_2 is now 2 times V_{CC}.

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 GND. This transfers a negative generated voltage to C_3. This generated voltage is regulated to a minimum voltage of -5.5V. Simultaneous with the transfer of the voltage to C_3, the positive side of capacitor C_1 is switched to V_{CC} and the negative side is connected to GND.

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 $-V_{CC}$ in the negative terminal of C_1, which is applied to the negative side of capacitor C_2. Since C_2^+ is at V_{CC}, the voltage potential across C_2 is 2 times V_{CC}.

Phase 4

— V_{DD} transfer — The fourth phase of the clock connects the negative terminal of C_2 to GND, and transfers this positive generated voltage across C_2 to C_4, the V_{DD} storage capacitor. This voltage is regulated to +5.5V. At this voltage, the internal oscillator is disabled. Simultaneous with the transfer of the voltage to C_4, the positive side of capacitor C_1 is switched to V_{CC} and the negative side is connected to GND, allowing the charge pump cycle to begin again. The charge pump cycle will continue as long as the operational conditions for the internal oscillator are present.

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 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 250kHz. The external capacitors can be as low as 0.1μF with a 16V breakdown voltage rating.

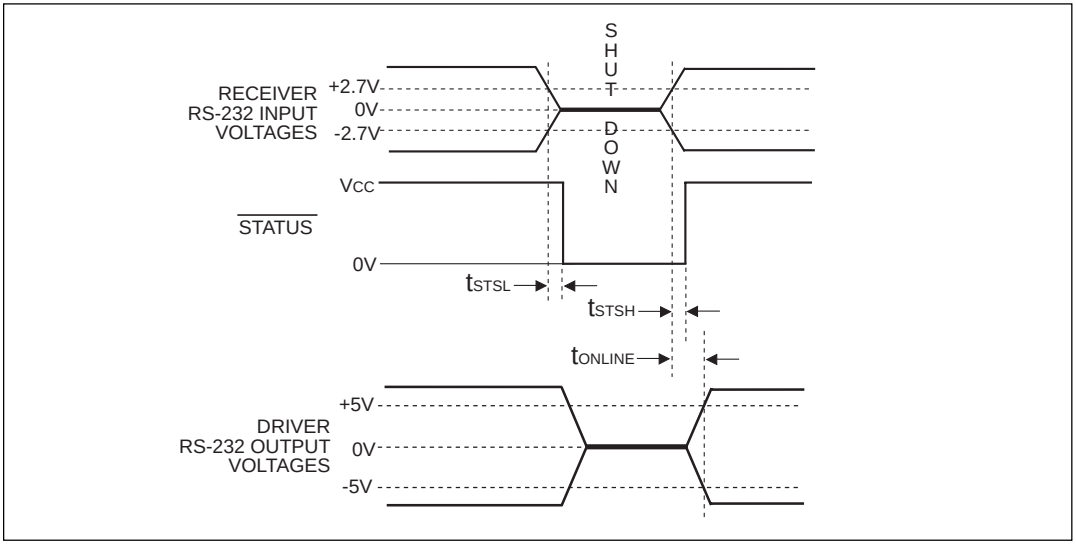


Figure 15. Auto-Online Timing Waveforms

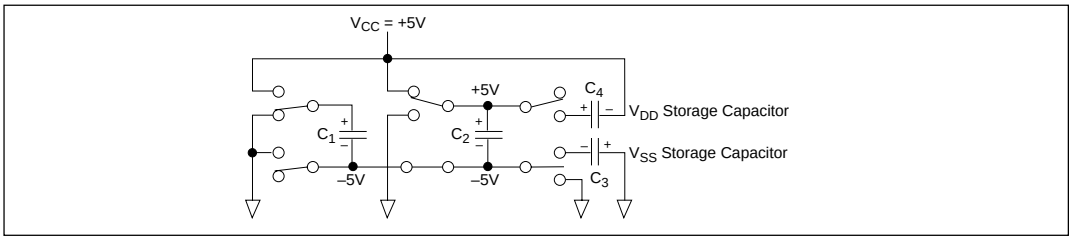


Figure 16. Charge Pump — Phase 1

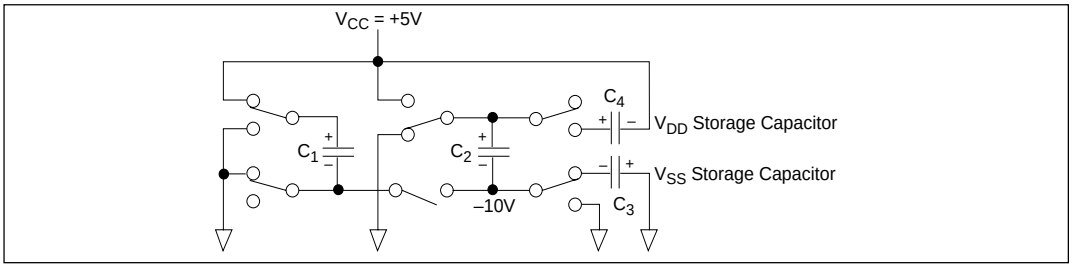


Figure 17. Charge Pump — Phase 2

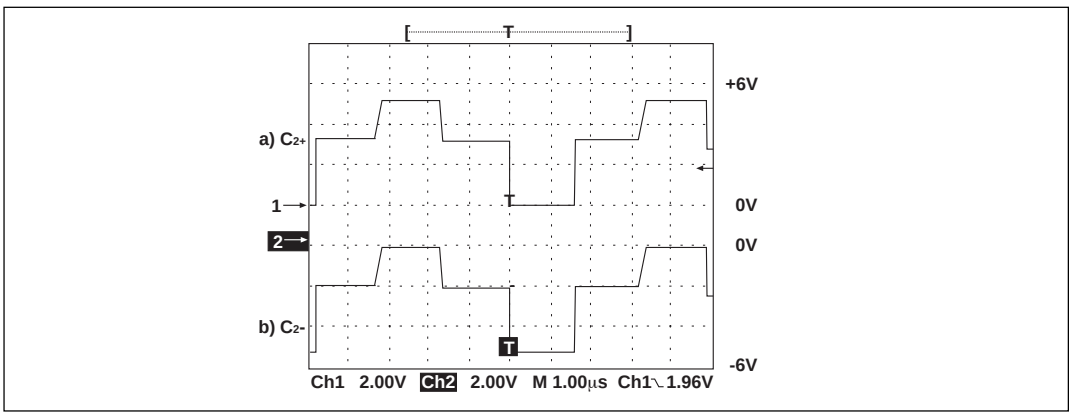


Figure 18. Charge Pump Waveforms

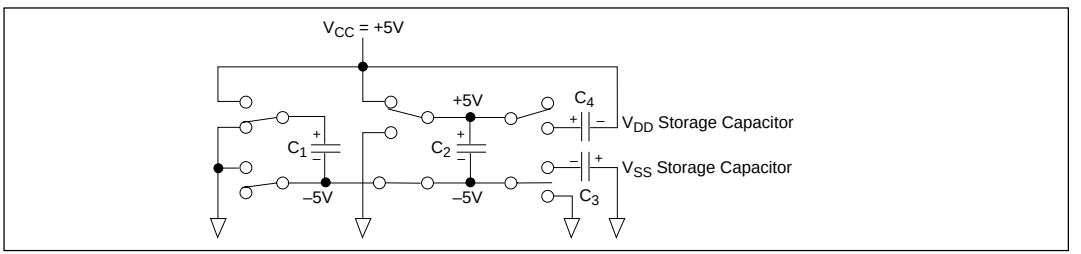


Figure 19. Charge Pump — Phase 3

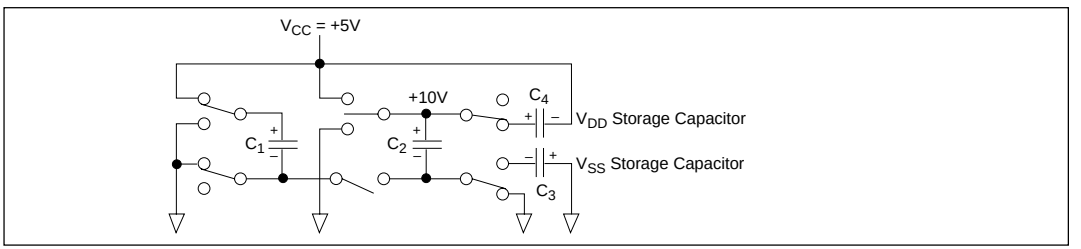


Figure 20. Charge Pump — Phase 4

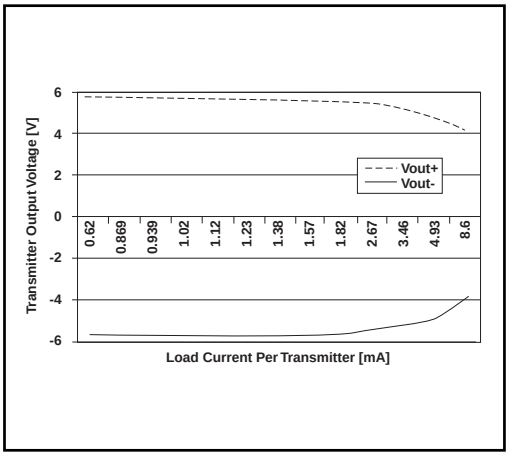


Figure 21. SP3243H Driver Output Voltages vs. Load Current per Transmitter

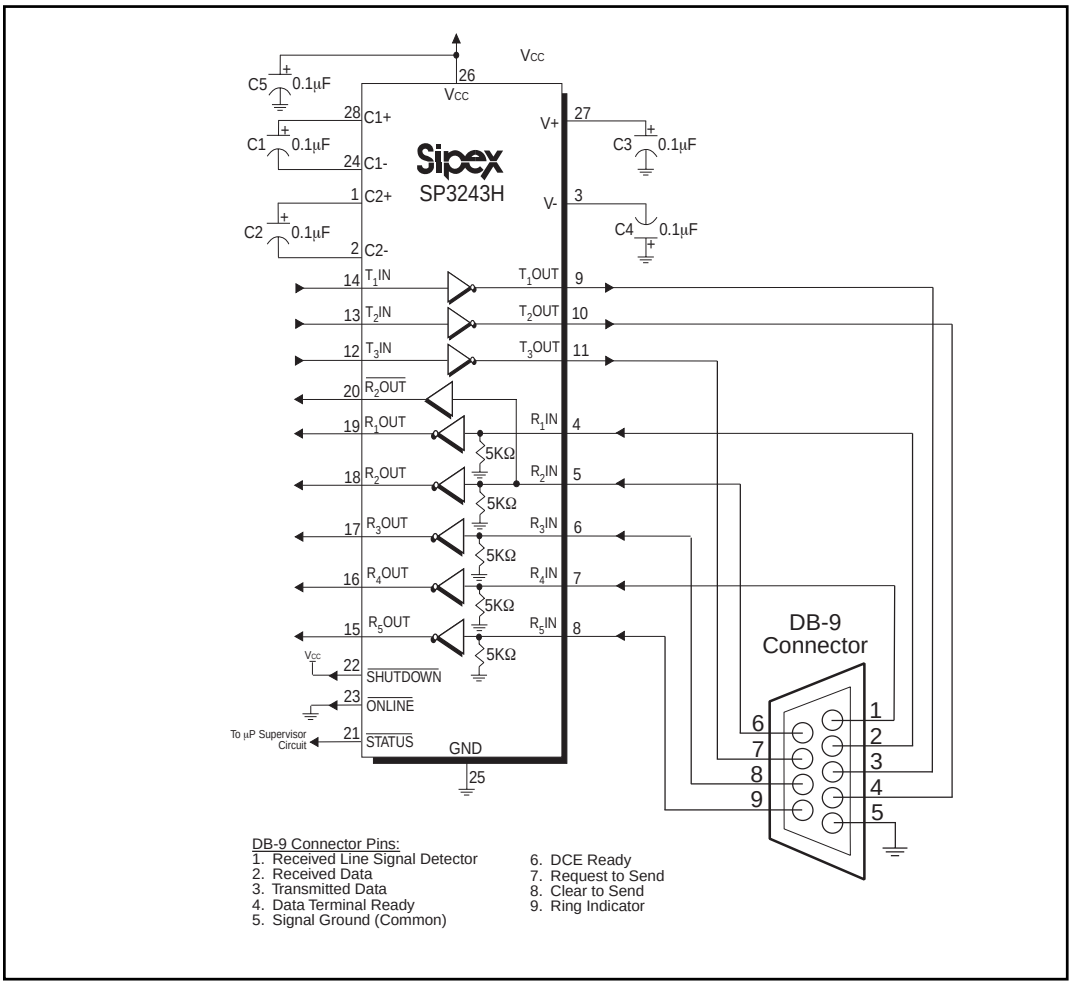


Figure 22. Circuit for the connectivity of the SP3243H with a DB-9 connector

RS-232 SIGNAL AT RECEIVER INPUT	$\overline{\text{SHUTDOWN}}$ INPUT	$\overline{\text{ONLINE}}$ INPUT	$\overline{\text{STATUS}}$ OUTPUT	TRANSCEIVER STATUS
YES	HIGH	-	HIGH	Normal Operation
NO	HIGH	HIGH	LOW	Normal Operation
NO	HIGH	LOW	LOW	Shutdown (***Auto-Online***)
YES	LOW	-	HIGH	Shutdown
NO	LOW	-	LOW	Shutdown

Table 3. Auto-Online Logic

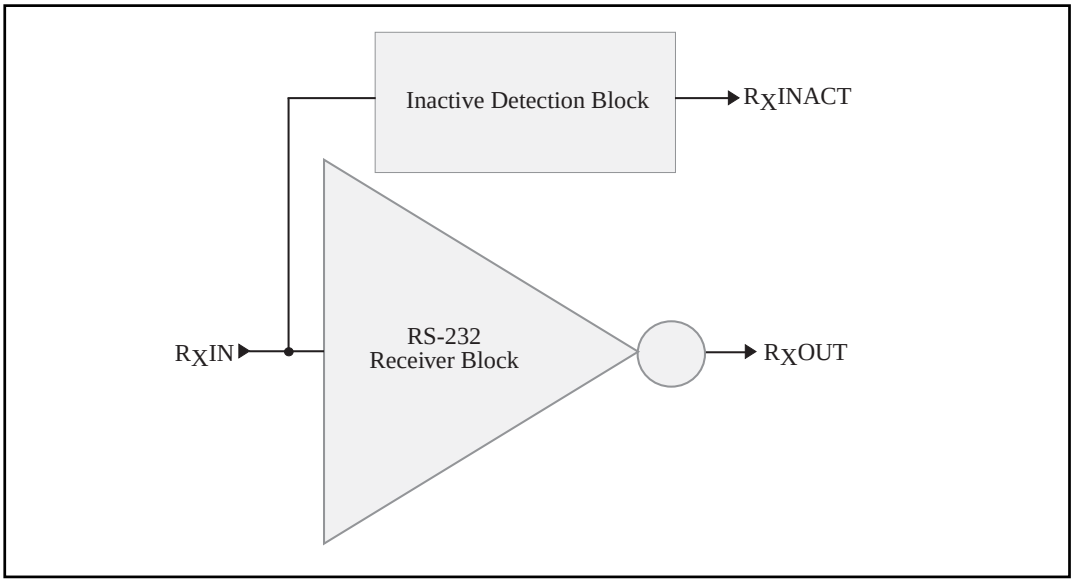


Figure 23. Stage I of Auto-Online Circuitry

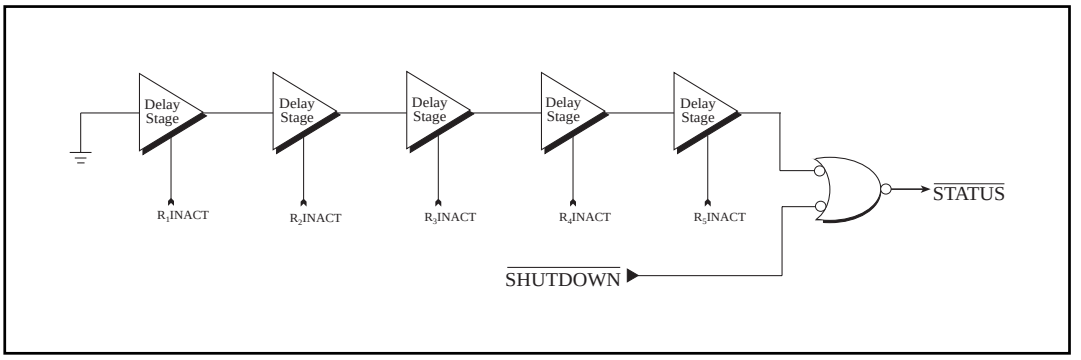


Figure 24. Stage II of Auto-Online Circuitry

Auto-Online Circuitry

The **SP3223H** and **SP3243H** devices have a patent pending ***Auto-Online*** circuitry on board that saves power in applications such as laptop computers, palmtop (PDA) computers and other portable systems.

The **SP3223H** and **SP3243H** devices incorporate an ***Auto-Online*** circuit that automatically enables itself when the external transmitters are enabled and the cable is connected. Conversely, the ***Auto-Online*** circuit also disables most of the internal circuitry when the device is not being used and goes into a standby mode where the device typically draws 1µA. This function can also be externally controlled by the $\overline{\text{ONLINE}}$ pin. When this pin is tied to a logic LOW, the ***Auto-Online*** function is active. Once active, the device is enabled until there is no activity on the receiver inputs. The receiver input typically sees at least ±3V, which are generated from the transmitters at the other end of the cable with a ±5V minimum. When the external transmitters are disabled or the cable is disconnected, the receiver inputs will be pulled down by their internal 5kΩ resistors to ground. When this occurs over a period of time, the internal transmitters will be disabled and the device goes into a shutdown or standy mode. When $\overline{\text{ONLINE}}$ is HIGH, the ***Auto-Online*** mode is disabled.

The ***Auto-Online*** circuit has two stages:

1) Inactive Detection
2) Accumulated Delay

The first stage, shown in *Figure 23*, detects an inactive input. A logic HIGH is asserted on R_XINACT if the cable is disconnected or the external transmitters are disabled. Otherwise, R_XINACT will be at a logic LOW. This circuit is duplicated for each of the other receivers.

The second stage of the ***Auto-Online*** circuitry, shown in *Figure 24*, processes all the receiver's R_XINACT signals with an accumulated delay that disables the device to a 1µA supply current. The $\overline{\text{STATUS}}$ pin goes to a logic LOW when the cable is disconnected, the external transmitters are disabled, or the $\overline{\text{SHUTDOWN}}$ pin is invoked. The typical accumulated delay is around 20µs.

When the **SP3223H** and **SP3243H** drivers or internal charge pump are disabled, the supply current is reduced to 1µA. This can commonly occur in hand-held or portable applications where the RS-232 cable is disconnected or the RS-232 drivers of the connected peripheral are turned off.

The ***Auto-Online*** mode can be disabled by the $\overline{\text{SHUTDOWN}}$ pin. If this pin is a logic LOW, the ***Auto-Online*** function will not operate regardless of the logic state of the $\overline{\text{ONLINE}}$ pin. *Table 3* summarizes the logic of the ***Auto-Online*** operating modes. The truth table logic of the **SP3223H** and **SP3243H** driver and receiver outputs can be found in *Table 2*.

The $\overline{\text{STATUS}}$ pin outputs a logic LOW signal if the device is shutdown. This pin goes to a logic HIGH when the external transmitters are enabled and the cable is connected.

When the **SP3223H** and **SP3243H** devices are shut down, the charge pumps are turned off. V+ charge pump output decays to V_{CC}, the V- output decays to GND. The decay time will depend on the size of capacitors used for the charge pump. Once in shutdown, the time required to exit the shut down state and have valid V+ and V- levels is typically 200µs.

For easy programming, the $\overline{\text{STATUS}}$ can be used to indicate DTR or a Ring Indicator signal. Tying $\overline{\text{ONLINE}}$ and $\overline{\text{SHUTDOWN}}$ together will bypass the ***Auto-Online*** circuitry so this connection acts like a shutdown input pin.

ESD TOLERANCE

The **SP3223H/3243H** series incorporates ruggedized ESD cells on all driver output and receiver input pins. The ESD structure is improved over our previous family for more rugged applications and environments sensitive to electro-static discharges and associated transients.

The Human Body Model has been the generally accepted ESD testing method for semi-conductors. This method is also specified in MIL-STD-883, Method 3015.7 for ESD testing.

The premise of this ESD test is to simulate the human body's potential to store electro-static energy and discharge it to an integrated circuit. The simulation is performed by using a test model as shown in *Figure 25*. This method will test the IC's capability to withstand an ESD transient during normal handling such as in manufacturing areas where the ICs tend to be handled frequently.

For the Human Body Model, the current limiting resistor (R_S) and the source capacitor (C_S) are 1.5kΩ an 100pF, respectively.

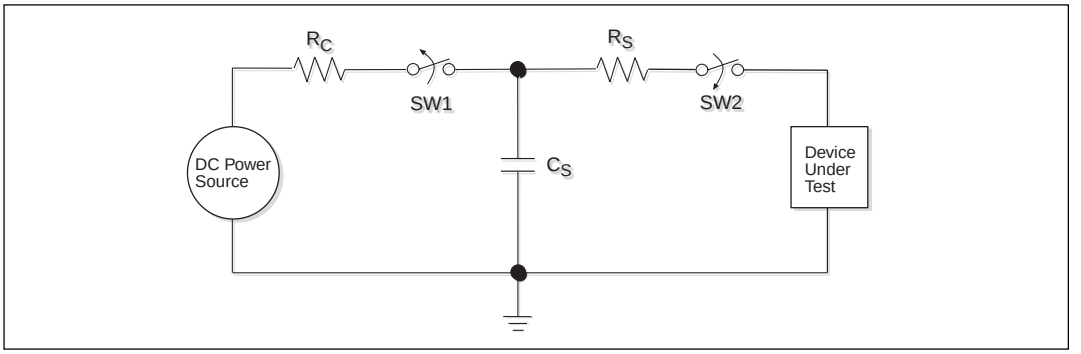
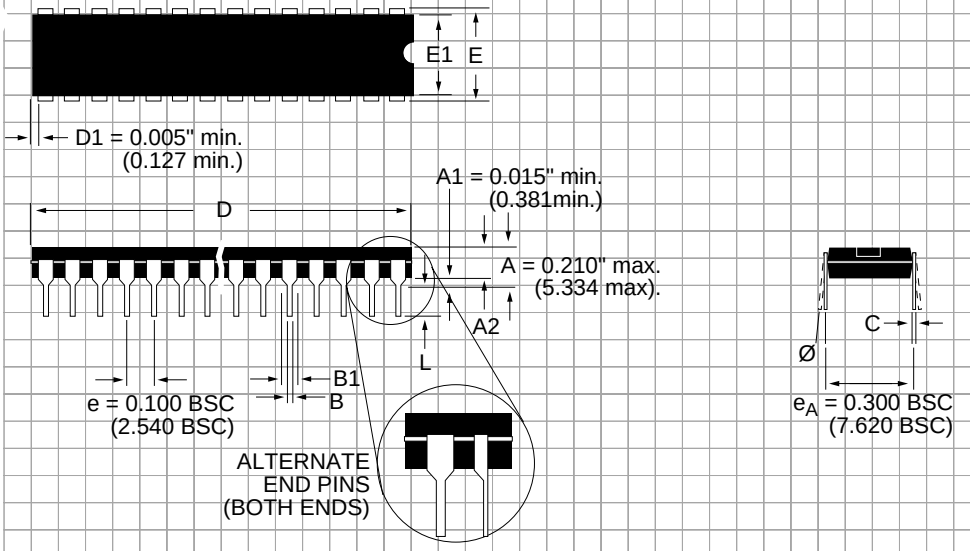


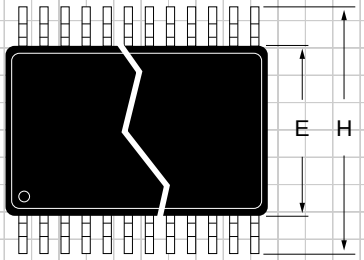
Figure 25. ESD Test Circuit for Human Body Model

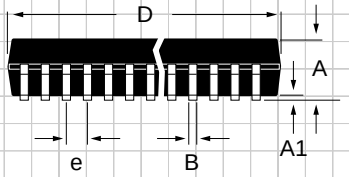
PACKAGE: PLASTIC DUAL–IN–LINE (NARROW)

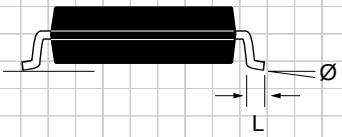


DIMENSIONS (Inches) Minimum/Maximum (mm)	16–PIN	20–PIN	28–PIN
A2	0.115/0.195 (2.921/4.953)	0.115/0.195 (2.921/4.953)	0.068/0.078 (1.73/1.99)
B	0.014/0.022 (0.356/0.559)	0.014/0.022 (0.356/0.559)	0.002/0.008 (0.05/0.21)
B1	0.045/0.070 (1.143/1.778)	0.045/0.070 (1.143/1.778)	0.010/0.015 (0.25/0.38)
C	0.008/0.014 (0.203/0.356)	0.008/0.014 (0.203/0.356)	0.397/0.407 (10.07/10.33)
D	0.780/0.800 (19.812/20.320)	0.980/1.060 (24.892/26.924)	0.205/0.212 (5.20/5.38)
E	0.300/0.325 (7.620/8.255)	0.300/0.325 (7.620/8.255)	0.0256 BSC (0.65 BSC)
E1	0.240/0.280 (6.096/7.112)	0.240/0.280 (6.096/7.112)	0.301/0.311 (7.65/7.90)
L	0.115/0.150 (2.921/3.810)	0.115/0.150 (2.921/3.810)	0.022/0.037 (0.55/0.95)
Ø	0°/ 15° (0°/15°)	0°/ 15° (0°/15°)	0°/8° (0°/8°)

PACKAGE: PLASTIC SHRINK SMALL OUTLINE (SSOP)

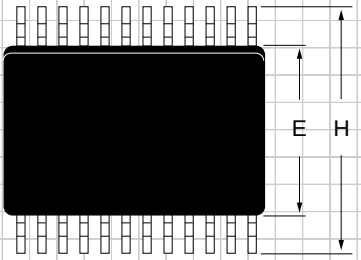


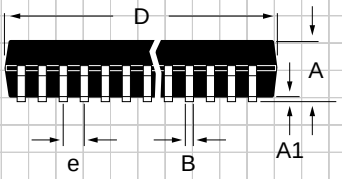




DIMENSIONS (Inches) Minimum/Maximum (mm)	16–PIN	20–PIN	24–PIN	28–PIN
A	0.068/0.078 (1.73/1.99)	0.068/0.078 (1.73/1.99)	0.068/0.078 (1.73/1.99)	0.068/0.078 (1.73/1.99)
A1	0.002/0.008 (0.05/0.21)	0.002/0.008 (0.05/0.21)	0.002/0.008 (0.05/0.21)	0.002/0.008 (0.05/0.21)
B	0.010/0.015 (0.25/0.38)	0.010/0.015 (0.25/0.38)	0.010/0.015 (0.25/0.38)	0.010/0.015 (0.25/0.38)
D	0.239/0.249 (6.07/6.33)	0.278/0.289 (7.07/7.33)	0.317/0.328 (8.07/8.33)	0.397/0.407 (10.07/10.33)
E	0.205/0.212 (5.20/5.38)	0.205/0.212 (5.20/5.38)	0.205/0.212 (5.20/5.38)	0.205/0.212 (5.20/5.38)
e	0.0256 BSC (0.65 BSC)	0.0256 BSC (0.65 BSC)	0.0256 BSC (0.65 BSC)	0.0256 BSC (0.65 BSC)
H	0.301/0.311 (7.65/7.90)	0.301/0.311 (7.65/7.90)	0.301/0.311 (7.65/7.90)	0.301/0.311 (7.65/7.90)
L	0.022/0.037 (0.55/0.95)	0.022/0.037 (0.55/0.95)	0.022/0.037 (0.55/0.95)	0.022/0.037 (0.55/0.95)
Ø	0°/8° (0°/8°)	0°/8° (0°/8°)	0°/8° (0°/8°)	0°/8° (0°/8°)

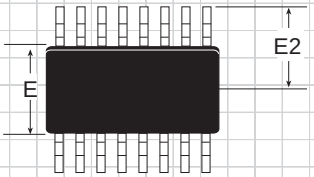
PACKAGE: PLASTIC SMALL OUTLINE (SOIC) (WIDE)

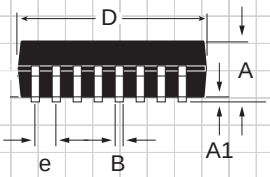


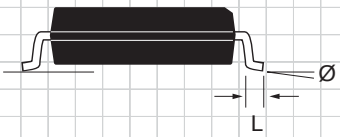


DIMENSIONS (Inches) Minimum/Maximum (mm)	28–PIN
A	0.093/0.104 (2.352/2.649)
A1	0.004/0.012 (0.102/0.300)
B	0.013/0.020 (0.330/0.508)
D	0.697/0.713 (17.70/18.09)
E	0.291/0.299 (7.402/7.600)
e	0.050 BSC (1.270 BSC)
H	0.394/0.419 (10.00/10.64)
L	0.016/0.050 (0.406/1.270)
Ø	0°/8° (0°/8°)

PACKAGE: PLASTIC THIN SMALL OUTLINE (TSSOP)







DIMENSIONS in inches (mm) Minimum/Maximum	20–PIN
A	- /0.043 (- /1.10)
A1	0.002/0.006 (0.05/0.15)
B	0.007/0.012 (0.19/0.30)
D	0.252/0.260 (6.40/6.60)
E	0.169/0.177 (4.30/4.50)
e	0.026 BSC (0.65 BSC)
E2	0.126 BSC (3.20 BSC)
L	0.020/0.030 (0.50/0.75)
Ø	0°/8°

ORDERING INFORMATION

Model	Temperature Range	Package Types
SP3223HCP	0°C to +70°C	20-pin PDIP
SP3223HCA	0°C to +70°C	20-pin SSOP
SP3223HCY	0°C to +70°C	20-pin TSSOP
SP3243HCT	0°C to +70°C	28-pin Wide SOIC
SP3243HCA	0°C to +70°C	28-pin SSOP

Please consult the factory for pricing and availability on a Tape-On-Reel option.

Sipex Corporation

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