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 to the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

V _{CC}	7V
Input Voltages	
	Logic0.5V to $(V_{CC} + 0.5V)$
	Drivers0.5V to (V_{CC} + 0.5V)
	Receivers±30V @ ≤100mA
Driver Outputs .	±15V
Maximum Data	Rate8Mbps ⁽¹⁾

Storage Temperature65°C to 15			
Power Dissipation			
28-pin WSOIC	1000mW		
Power Derating, Ø _{JA}			
28-pin WSOIC	40°C/W		

Electrical Characteristics

Limits are specified at $T_A = 25^{\circ}C$ and $V_{CC} = 5.0V$ unless otherwise noted.

Parameters	Min.	Тур.	Max.	Units	Conditions
RS-485 Driver DC Characteristics					
Differential output voltage			Vcc	Volts	Unloaded; R = ∞Ω; See Figure 1
Differential output voltage	2.0		5.0	Volts	With load; R = 50Ω (RS-422); See Figure 1
Differential output voltage	1.5		5.0	Volts	With load; R = 27Ω (RS-485); See Figure 1
Change in magnitude of driver differential output voltage for complementary states			0.2	Volts	R = 27Ω or R = 50Ω; See Figure 1
Driver common-mode output voltage			3	Volts	R = 27Ω or R = 50Ω; See Figure 1
Input high voltage	2.0			Volts	Applies to transmitter inputs, SEL A, SEL B, SD and LB
Input low voltage			0.8	Volts	Applies to transmitter inputs, SEL A, SEL B, SD and LB
Input current			±10	μA	Applies to transmitter inputs, SEL A, SEL B, SD and LB
Pull-up current		1.5		μA	
Pull-down current		3.0		μA	
Driver short circuit current V _{OUT} = HIGH	35		250	mA	-7V ≤ V _O ≤ 10V
Driver short circuit current V _{OUT} = LOW	35		250	mA	-7V ≤ V _O ≤ 10V
RS-485 Driver AC Characteristics					
Driver data rate	10			Mbps	
Driver data rate			8	Mbps	T _A = 85°C ⁽¹⁾
Driver input to output t _{PLH}		70	180	ns	R_{DIFF} = 54 Ω , C_{L1} = C_{L2} = 100pF; see Figures 3 and 5
Driver input to output t _{PHL}		70	180	ns	R_{DIFF} = 54 Ω , C_{L1} = C_{L2} = 100pF; see Figures 3 and 5
Driver skew		5	10	ns	From output to output; see Figures 3 and 5
Driver rise or fall time	3	15	40	ns	From 10% to 90%; R_{DIFF} = 54 Ω , C_{L1} = C_{L2} = 100pF; see Figures 3 and 5

Electrical Characteristics (Continued)

Limits are specified at $T_A = 25^{\circ} C$ and $V_{CC} = 5.0 V$ unless otherwise noted.

Parameters	Min.	Тур.	Max.	Units	Conditions
RS-485 Receiver DC Characteristic	s				
Differential input threshold	-0.2		0.2	Volts	-7V ≤ V _{CM} ≤ 12V
Input hysteresis		70		mV	V _{CM} = 0V
Output voltage HIGH	3.5			Volts	I _O = -4mA, V _{ID} = 200mV
Output voltage LOW			0.4	Volts	I _O = 4mA, V _{ID} = -200mV
Input resistance	12	15		kΩ	-7V ≤ V _{CM} ≤ 12V
Input current (A, B); V _{IN} = 12V			1.5	mA	V _{IN} = 12V, A is the non-inverting receiver input. B is the inverting receiver input
Input current (A, B); V _{IN} = -7V			-0.8	mA	V _{IN} = -7V
Short circuit current			85	mA	$0V \le V_{CM} \le V_{CC}$
RS-485 Receiver AC Characteristics	S				
Receiver data rate	10			Mbps	
Receiver data rate			8	Mbps	$T_A = 85^{\circ}C^{(1)}$
Receiver input to output t _{PLH}		130	250	ns	R_{DIFF} = 54 Ω , C_{L1} = C_{L2} = 100pF; Figures 3 and 6
Receiver input to output t _{PHL}		130	250	ns	R_{DIFF} = 54 Ω , C_{L1} = C_{L2} = 100pF; Figures 3 and 6
Differential receiver skew tphL - tpLH		13		ns	R_{DIFF} = 54 Ω , C_{L1} = C_{L2} = 100pF; Figures 3 and 6
RS-232 Driver DC Characteristics					
TTL input level V _{IL}			0.8	Volts	Applies to transmitter inputs, SELA, SELB, SD and LB
TTL input level V _{IH}	2.0			Volts	Applies to transmitter inputs, SELA, SELB, SD and LB
High level voltage output	5.0		15.0	Volts	$R_L = 3k\Omega$ to GND
Low level voltage output	-15.0		-5.0	Volts	$R_L = 3k\Omega$ to GND
Open circuit output			±15	Volts	R _L = ∞
Short circuit current			±100	mA	V _{OUT} = 0V
Power off impedance	300			Ω	V _{CC} = 0V; V _{OUT} = ±2V
RS-232 Driver AC Characteristics					
Transmission rate	120			kbps	
Transition time			1.56	μs	Rise/fall time, 3V to -3V; -3V to 3V, R_L = 3k Ω , C_L = 2500pF
Propagation delay; t _{PHL}		2	4	μs	R_L = 3k Ω , C_L = 2500pF, from 1.5V of T_{IN} to 50% of V_{OUT}
Propagation delay; t _{PLH}		2	4	μs	R_L = 3k Ω , C_L = 2500pF, from 1.5V of T_{IN} to 50% of V_{OUT}
Slew rate		10	30	V/µs	$R_L = 3k\Omega$, $C_L = 50pF$; From 3V to -3V or -3V to 3V

Electrical Characteristics (Continued)

Limits are specified at $T_A = 25^{\circ} C$ and $V_{CC} = 5.0 V$ unless otherwise noted.

Parameters	Min.	Тур.	Max.	Units	Conditions	
RS-232 Receiver DC Characteristics						
TTL output level; V _{OL}			0.4	Volts	I _{SINK} = 4mA	
TTL output level; V _{OH}	3.5			Volts	I _{SOURCE} = -4mA	
Input high threshold		2.1	3.0	Volts		
Input low threshold	0.8	1.6		Volts		
Input voltage range	-15		15	Volts		
Input impedance	3	5	7	kΩ	V _{IN} = ±15V	
Hysteresis	0.2	0.5	1.0	Volts	V _{CC} = 5V	
RS-232 Receiver AC Characteristics						
Transmission rate	120			kbps		
Transition time		50		ns	Rise/fall time, 10% to 90%	
Propagation delay t _{PHL}		100	300	ns	From FOOV of V to 4 FV of D	
Propagation delay t _{PLH}		100	200	ns	From 50% of V _{IN} to 1.5V of R _{OUT}	
Power Requirements	Power Requirements					
No load supply current		19	25	mA	No load; V _{CC} = 5.0V; T _A = 25°C	
Full load supply current		90	120	mA	RS-232 drivers R _L = $3k\Omega$ to GND, DC input RS-485 drivers R _L = 54Ω from A to B; DC input	
Shutdown supply current		5	50	μA	T _A = 25°C, V _{CC} = 5.0V	

NOTE

^{1.} Exceeding the maximum data rate may damage the device.

Test Circuits

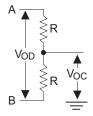


Figure 1: RS-485 Driver DC Test Load Circuit

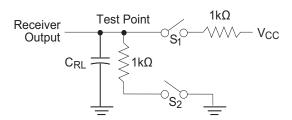


Figure 2. Receiver Timing Test Load Circuit

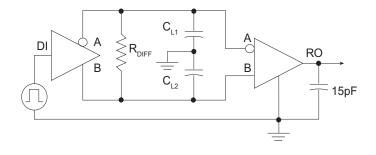


Figure 3: RS-485 Driver/Receiver Timing Test Circuit

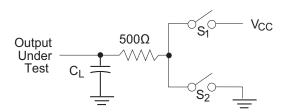


Figure 4: RS-485 Driver Timing Test Load #2 Circuit

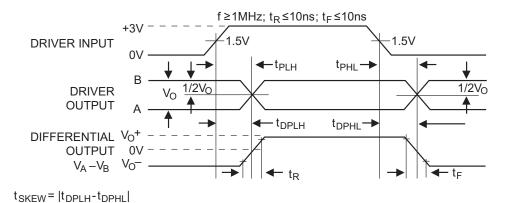


Figure 5: RS-485 Driver Propagation Delays

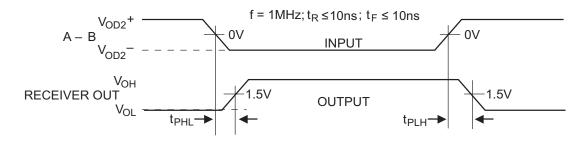
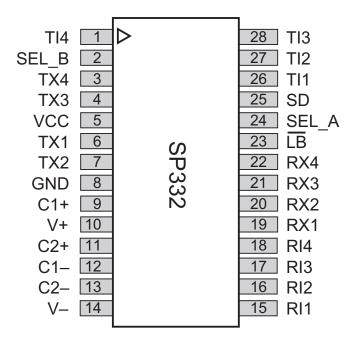


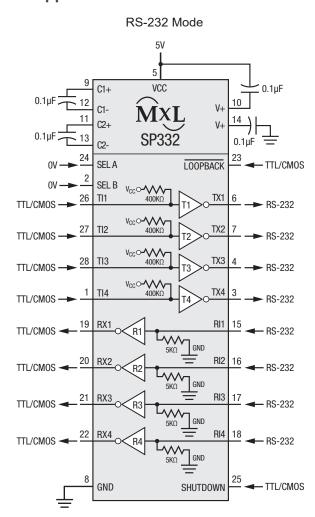
Figure 6: RS-485 Receiver Propagation Delays



Pin Configuration



Typical Applications Circuits



5V 5 0.1μF 12 0.1μF 13 0.1μF 14 0.1μF 15 0.1μF 17 0.1μF 17 0.1μF 18 0.1μF 18 0.1μF 19 0.1μF

Full Duplex RS-485 Mode Mode

SP332 Control Logic Configuration

SELA	0	0	1	1
SEL B	0	1	0	1
LB	1	1	1	1
SD	0	0	0	0
	26 T11 T1 TX1 6 27 T12 T2 TX2 7 28 T13 T3 TX3 4 1 T14 T4 TX4 3 19 RX1 R1 R11 15 20 RX2 R2 R12 16 21 RX3 R3 R13 17 22 RX4 R4 R14 18	26 TI1 T1 TX1 6 27 TI2 T2 TX2 7 28 TI3 T3 TX4 3 19 RX1 R1 RI1 15 20 RX2 R2 RI2 16 21 RX3 R3 RI4 18	26 TI1 TX1 6 27 TX2 7 28 TI3 T3 TX3 4 1 TI4 T4 TX4 3 19 RX1 R1 R12 16 21 RX3 R3 RI3 17 22 RX4 R4 RI4 18	26 TI1 TX1 6 TX2 7 28 TI3 TX3 4 T3 TX4 3 19 RX1 RI 15 RI2 16 21 RX3 RI3 17 R3 RI4 18
SELA	0	0	1	1
SEL B	0	1	0	1
LB	0	0	0	0
SD	0	0	0	0
	26 Til Ti TX1 6 27 Ti2 T2 TX2 7 28 Ti3 T3 TX3 4 1 Ti4 T4 TX4 3 19 RX1 R1 15 20 RX2 R2 R2 R12 16 21 RX3 R3 R3 R13 17 22 RX4 R4 R14 18	26 TI1 TX1 6 27 TI2 TZ 7 28 TI3 T3 TX4 3 19 RX1 R1 15 20 RX2 R2 R12 16 R12 16 R13 17 R14 18	26 Ti1 Ti TiX1 6 TX2 7 28 Ti3 T3 TX3 4 1 Ti4 T4 TX4 3 RI1 15 RI2 16 RI3 17 22 RX4 R4 RI4 18	26 TI1 T1 TX1 6 TX2 7 28 TI3 T3 TX4 3 19 RX1 R1 15 R12 16 21 RX3 R3 R13 17 R14 18

Receiver Inputs are inactive in Loopback Mode ($\overline{\text{LOOPBACK}} = 0$)

Driver Outputs are Tri-stated in Loopback Mode (LOOPBACK = 0)

Unused Outputs are Tri-stated



Functional Description

The SP332 is single chip device that can be configured via software for either RS-232, RS-485 or both interface modes at any time. The SP332 is made up of three basic circuit elements, single-ended drivers and receivers, differential drivers and receivers and charge pump.

Differential Driver/Receiver

RS-485, RS-422 Drivers

The differential drivers and receivers comply with the RS-485 and RS-422 standards. The driver circuits are able to drive a minimum of 1.5V when terminated with a 54Ω resistor across the two outputs. The typical propagation delay from driver input to output is 60ns. The driver outputs are current limited to less than 250mA, and can tolerate shorts to ground, or to any voltage within a 10V to -7V range with no damage.

RS-485, RS-422 Receivers

The differential receivers of the SP332 comply with the RS-485 and RS-422 standards. The input to the receiver is equipped with a common mode range of 12V to -7V. The input threshold over this range is a minimum of ±200mV. The differential receivers can receive data up to 10Mbps. The typical propagation delay from the receiver input to output is 90ns.

Single Ended Driver / Receiver

RS-232 (V.28) Drivers

The single-ended drivers and receivers comply with the RS-232 and V.28 standards. The drivers are inverting transmitters which accept either TTL or CMOS inputs and output the RS-232 signals with an inverted sense relative to the input logic levels. Typically, the RS-232 driver output voltage swing is $\pm 9V$ with no load and is guaranteed to be greater than $\pm 5V$ under full load. The drivers rely on the V+ and V- voltages generated by the on-chip charge pump to maintain proper RS-232 output levels. With worst case load conditions of $3k\Omega$ and 2500pF, the four RS-232 drivers can still maintain $\pm 5V$ output levels. The drivers can operate up to 120kbps; the propagation delay from input to output is typically $2\mu s$.

RS-232 (V.28) Receivers

The RS-232 receivers convert RS-232 input signals to inverted TTL signals. Each of the four receivers features 500mV of hysteresis margin to minimize the affects of noisy transmission lines. The inputs also have a $5k\Omega$ resistor to ground, in an open circuit situation the input of the receiver will be forced low, committing the output to a logic high state. The input resistance will maintain $3k\Omega$ to

 $7k\Omega$ over a ±15V range. The maximum operating voltage range for the receiver is ±30V, under these conditions the input current to the receiver must be limited to less than 100mA. Due to the on-chip ESD protection circuitry, the receiver inputs will be clamped to ±15V levels. The RS-232 receivers can operate up to 120kbps.

Charge-Pump

The charge pump is a MaxLinear-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 attain symmetrical to 10V power supplies. Figure 7(a) shows the waveform found on the positive side of capacitor C_2 , and Figure 7(b) shows the negative side of capacitor C2. 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 charge on 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 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



REV 1.0.1 8/11

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 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 15kHz. The external capacitors must be $0.1\mu F$ with a 16V breakdown rating.

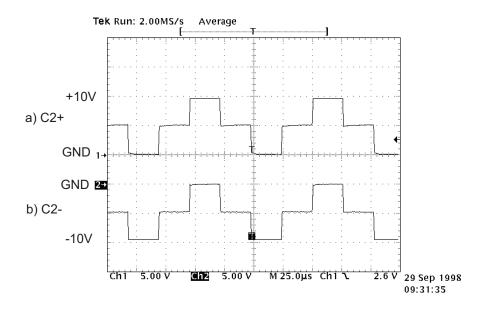


Figure 7: Charge Pump Waveforms

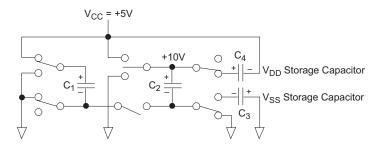


Figure 8: Charge Pump Phase 1

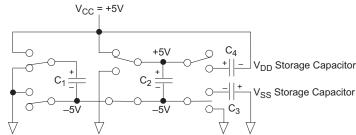


Figure 9: Charge Pump Phase 3

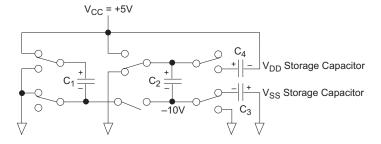


Figure 10: Charge Pump Phase 2

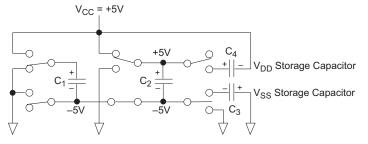
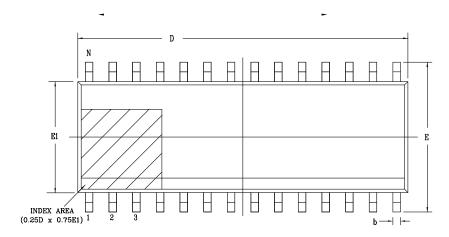


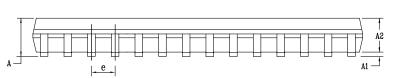
Figure 11: Charge Pump Phase 4

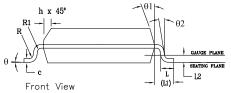
Package Description

WSOIC28

Top View







Side View

Front View

	DACK						
PACKAGE OUTLINE SOIC .300" BODY JEDEC MS-013 VARIATION AE							
	COMMON DIMENSIONS IN MM COMMON				DIMENSIONS	S IN MM	
SYMBOLS	(Co	ntrol Unit)		(Refe	(Reference Unit)		
Ī	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	1	0.020	
С	0.20	ı	0.33	0.008	-	0.013	
Ε	1	0.30 BS	С	0.406 BSC			
E1		7.50 BS0)	0.295 BSC			
е		1.27 BS0)	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 BS0)	0.	.010 BS	2	
R	0.07	ı	1	0.003	-	_	
R1	0.07	_	_	0.003	_	-	
θ	0,	_	8*	0,	_	8.	
θ1	5°	_	15°	5°	_	15°	
θ2	0,	_	_	0,	_	_	
D	17.90 BSC 0.705 BSC					iC	
N	28						

Drawing No: POD-00000106

Revision: A



Ordering Information⁽¹⁾

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
SP332CT-L	0°C to 70°C			Tube
SP332CT-L/TR ⁽³⁾	0 0 10 70 0	Yes ⁽²⁾	20 nin WSOIC	Reel
SP332ET-L	40°C to 95°C		28-pin WSOIC	Tube
SP332ET-L/TR	-40°C to 85°C			Reel

NOTE:

- 1. Refer to www.exar.com/SP332 for most up-to-date Ordering Information.
- 2. Visit www.exar.com for additional information on Environmental Rating.
- 3. NRND Not recommended for new designs.

Revision History

Revision	Date	Description
9617RO	-	Legacy Sipex Datasheet
01/26/10	1.0.0	Convert to Exar Format. Add Revision History table. Change revision to 1.0.0. Add Note 1 and change maximum RS-485 data rate at +85C. Update ABS Max Rating table.
10/16/17	1.0.1	Remove GND from Differential Output Voltage min (page 2). Update to MaxLinear logo. Update format and ordering information table. Theory of Operation section moved to after SP332 Control Logic Configuration section, and renamed Functional Description.



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