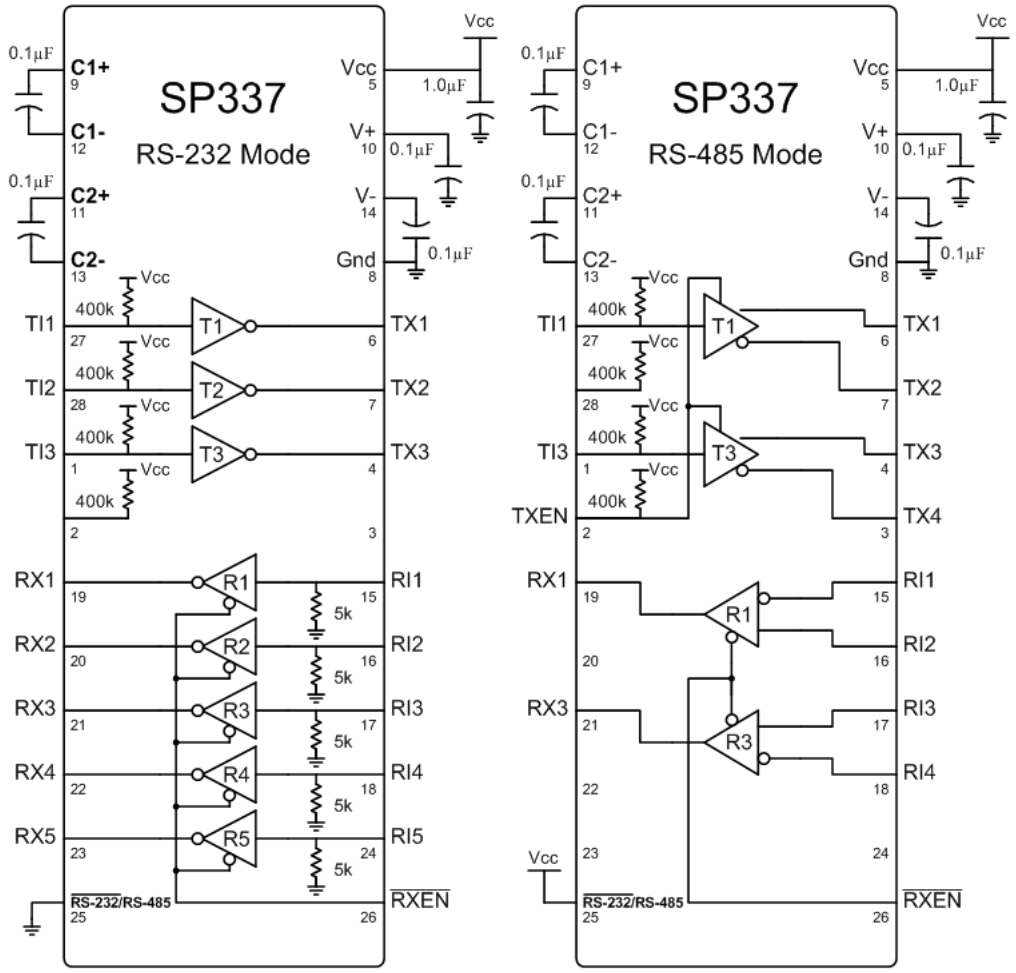
FIGURE 1. TYPICAL RS-232 AND RS-485 APPLICATION CIRCUITS



ORDERING INFORMATION

PART NUMBER	PACKAGE	OPERATING TEMPERATURE RANGE	DEVICE STATUS
SP337EBCT-L	28-pin WSOIC	0°C to +70°C	Active
SP337EBCY-L	28-pin TSSOP	0°C to +70°C	Active
SP337EBET-L	28-pin WSOIC	-40°C to +85°C	Active
SP337EBEY-L	28-pin TSSOP	-40°C to +85°C	Active
SP337EUCT-L	28-pin WSOIC	0°C to +70°C	Active
SP337EUCY-L	28-pin TSSOP	0°C to +70°C	Active
SP337EUET-L	28-pin WSOIC	-40°C to +85°C	Active
SP337EUEY-L	28-pin TSSOP	-40°C to +85°C	Active

PIN DESCRIPTIONS

Pin Assignments

PIN #	PIN NAME	TYPE	DESCRIPTION	
			RS-232	RS-485/RS-422
1	TI3	Input	T3 Driver TTL input	T3 Driver TTL input
			This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode.	
2	TXEN	Input	X*	Only RS-485 mode
			This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode.	
3	TX4	Output	X*	T3(Z) Inverting Output
4	TX3	Output	T3 Driver Output	T3(Y) Non-Inverting Output
5	Vcc	Power	Power Supply Voltage, between 3.3V and 5V	
6	TX1	Output	T1 Driver Output	T1(Y) Non-Inverting Output
7	TX2	Output	T2 Driver Output	T1(Z) Inverting Output
8	GND	Power	Ground	
9	C1+	Pump	Positive Terminal of Positive Flying Capacitor	
10	V+	Pump	Vdd Storage Capacitor	
11	C2+	Pump	Positive Terminal of Negative Flying Capacitor	
12	C1-	Pump	Negative Terminal of Positive Flying Capacitor	
13	C2-	Pump	Negative Terminal of Negative Flying Capacitor	
14	V-	Pump	Vss Storage Capacitor	
15	RI1	Input	R1 Receiver Input, 5k pull-down	R1(B) Receiver Inverting Input
16	RI2	Input	R2 Receiver Input, 5k pull-down	R1(A) Receiver Non-Inverting Input
17	RI3	Input	R3 Receiver Input, 5k pull-down	R3(A) Receiver Non-Inverting Input
18	RI4	Input	R4 Receiver Input, 5k pull-down	R3(B) Receiver Inverting Input
19	RX1	Output	R1 Receiver Output	
20	RX2	Output	R2 Receiver Output	X*
21	RX3	Output	R3 Receiver Output	
22	RX4	Output	R4 Receiver Output	X*
23	RX5	Output	R5 Receiver Output	X*
24	RI5	Input	R5 Receiver Input, 5k pull-down	X*
25	$\overline{\text{RS232}}$/RS485	Input	Mode select, either RS-232 (low) or RS-485/422 (high) mode	
26	$\overline{\text{RXEN}}$	Input	Receiver enable for both RS-232 and RS-485/422 mode (Active low)	

Pin Assignments

PIN #	PIN NAME	TYPE	DESCRIPTION	
			RS-232	RS-485/RS-422
27	TI1	Input	T1 Driver Input	T1 Driver Input
			This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode.	
28	TI2	Input	T2 Driver Input	X*
			This pin has a 400k pull-up to Vcc in both RS-232 and RS-485 modes. The pull-up is disabled in the SP337EU shutdown mode.	

* Pins marked with an X in the above table are ignored or "don't care" in the listed mode, provided they do not exceed Vcc or go below ground. Some of these pins have a pull-up to Vcc which remains active in both RS-232 and RS-485 mode, but is disabled in the SP337EU shutdown mode.

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 and cause permanent damage to the device.

Supply Voltage V_{CC}	+6.0V
Receiver Input V_{IN} (DC Input Voltage)	-16V to +16V
Input Voltage at TTL input Pins	-0.3V to Vcc + 0.5V
Driver Output Voltage (from Ground)	-7.5V to +12.5V
Short Circuit Duration, TXout to GND	Continuous
Storage Temperature Range	-65°C to + 150°C
Lead Temperature (soldering, 10s)	+300°C
Power Dissipation 28-pin SOIC-W (derate 17mW/°C above +70°C)	938mW
Power Dissipation 28-pin TSSOP (derate 12mW/°C above +70°C)	657mW

CAUTION:

ESD (Electrostatic Discharge) sensitive device. Permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. Personnel should be properly grounded prior to handling this device. The protective foam should be discharged to the destination socket before devices are removed.

ELECTRICAL CHARACTERISTICS

UNLESS OTHERWISE NOTED: VCC = +3.3V +/-5% OR +5.0V +/-5%, C1-C4 = 0.1μF; TA = TMIN TO TMAX.
TYPICAL VALUES ARE AT VCC = 3.3V, TA = +25°C.

SYMBOL	PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
DC CHARACTERISTICS						
I_{CC}	Supply Current (RS-232)		1.5	6.0	mA	No Load, RS232/RS485 = 0V
I_{CC}	Supply Current (RS-485)		7.0	15	mA	No Load, RS232/RS485 = Vcc
I_{CC}	Vcc Shutdown Current (SP337EU only)		1.0	10.0	μA	TXEN = 0V, RXEN = Vcc (SP337EU only)
TRANSMITTER and LOGIC INPUT PINS: Pins 1, 2, 25, 26, 27, 28						
V_{IH}	Logic Input Voltage HIGH	2.0			V	Vcc = 3.3V
V_{IH}	Logic Input Voltage HIGH	2.4			V	Vcc = 5.0V
V_{IL}	Logic Input Voltage LOW			0.8	V	
I_{IL}	Logic Input Leakage Current			1.0	μA	Input High (Vin = Vcc)
I_{PU}	Logic Input Pull-up Current			15.0	μA	Input Low (Vin = 0V)
V_{HYS}	Logic Input Hysteresis		0.5		V	
RS-232 and RS-485/422 RECEIVER OUTPUTS: Pins 19, 20, 21, 22, 23						
V_{OH}	Receiver Output Voltage HIGH	Vcc-0.6			V	I_{OUT} = 1.0mA
V_{OL}	Receiver Output Voltage LOW			0.4	V	I_{OUT} = -3.2mA

UNLESS OTHERWISE NOTED: VCC = +3.3V +/-5% OR +5.0V +/-5%, C1-C4 = 0.1µF; TA = TMIN TO TMAX.
TYPICAL VALUES ARE AT VCC = 3.3V, TA = +25°C.

SYMBOL	PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
I_{OSS}	Receiver Output ShortCircuit Current		+/-40	+/-65	mA	0 < Vo < Vcc
I_{OZ}	Receiver Output Leakage Current		+/-0.1	+/-1.5	µA	Receivers Disabled
SINGLE-ENDED RECEIVER INPUTS (RS-232)						
	Input Voltage Range	-15		+15	V	
	Input Threshold Low	0.6	1.2		V	V_{CC} = 3.3V
		0.8	1.5		V	V_{CC} = 5.0V
	Input Threshold HIGH		1.5	2.0	V	V_{CC} = 3.3V
			1.8	2.4	V	V_{CC} = 5.0V
	Input Hysteresis		0.5		V	
	Input Resistance	3	5	7	kΩ	
DIFFERENTIAL RECEIVER INPUTS (RS-485 / RS-422)						
R_{IN}	Receiver Input Resistance	96			kΩ	-7V ≤ V_{CM} ≤ +12V
V_{TH}	Receiver Differential Threshold	-200	-125	-50	mV	
ΔV_{TH}	Receiver Input Hysteresis		30		mV	V_{CM} = 0V
I_{IN}	Input Current			125	µA	V_{IN} = 12V
				-100	µA	V_{IN} = -7V
SINGLE-ENDED DRIVER OUTPUTS (RS-232)						
V_O	Output Voltage Swing	+/-5.0	+/-5.4		V	Output Loaded with 3kΩ to Gnd
				+/-7.0	V	No Load Output
	Short Circuit Current			+/-60	mA	V_O = 0V
	Power Off Impedance	300	10M		W	Vcc = 0V; V_O = +/-2V
DIFFERENTIAL DRIVER OUTPUTS (RS-485 / RS-422)						
V_{OD}	Differential Driver Output (Tx_Out)	2		Vcc	V	R_L = 100Ω (RS-422), Figure 2
		1.5		Vcc	V	R_L = 54Ω (RS-485), Figure 2
		1.5		Vcc	V	V_{CM} = -7V, Figure 3
		1.5		Vcc	V	V_{CM} = +12V, Figure 3
ΔV_{OD}	Change In Magnitude of Differential Output Voltage	-0.2		+0.2	V	R_L = 54Ω or 100Ω, Figure 2
V_{OC}	Driver CommonMode Output Voltage			3	V	R_L = 54Ω or 100Ω, Figure 2
ΔV_{OC}	Change In Magnitude of Common Mode Output Voltage			0.2	V	R_L = 54Ω or 100Ω, Figure 2
I_{OSD}	Driver Output Short Circuit Current			+/-250	mA	V = +12V to -7V, Figure 4
I_O	Output Leakage Current			+/-100	µA	TXEN = 0V or Shutdown, V_O = +12V to -7V
TIMING CHARACTERISTICS						

UNLESS OTHERWISE NOTED: VCC = +3.3V +/-5% OR +5.0V +/-5%, C1-C4 = 0.1µF; TA = TMIN TO TMAX.
TYPICAL VALUES ARE AT VCC = 3.3V, TA = +25°C.

SYMBOL	PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
RS-232 (SP337EB ONLY) DATA RATE = 250kbps, ONE TRANSMITTER SWITCHING						
	Maximum Data Rate	250			kbps	R_L = 3kΩ, C_L = 2500pF
t_{PHL}, t_{PLH}	Receiver Propagation Delay		100		ns	C_L = 150pF, Figures 20 and 21
$\lvert t_{PHL}-t_{PLH} \rvert$	Receiver Skew			100	ns	C_L = 150pF, Figures 20 and 21
t_{PHL}, t_{PLH}	Driver Propagation Delay		800			
$\lvert t_{PHL}-t_{PLH} \rvert$	Driver Skew			400	ns	
	Receiver Output Enable time			400	ns	
	Receiver Output Disable time			400	ns	
t_{THL}, t_{TLH}	Transition-Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V	4		30	V/µs	Vcc = 3.3V, R_L = 3kΩ to 7kΩ, C_L = 150pF to 2500pF, Figures 18 and 19
RS-232 (SP337EU ONLY) DATA RATE = 1Mbps, ONE TRANSMITTER SWITCHING						
	Maximum Data Rate	1			Mbps	R_L = 3kΩ, C_L = 250pF
t_{PHL}, t_{PLH}	Receiver Propagation Delay		100		ns	C_L = 150pF, Figures 20 and 21
$\lvert t_{PHL}-t_{PLH} \rvert$	Receiver Skew			100	ns	C_L = 150pF, Figures 20 and 21
t_{PHL}, t_{PLH}	Driver Propagation Delay		250			
$\lvert t_{PHL}-t_{PLH} \rvert$	Driver Skew			150	ns	
	Receiver Output Enable time			400	ns	
	Receiver Output Disable time			400	ns	
t_{THL}, t_{TLH}	Transition-Region Slew Rate from +3.0V to -3.0V or -3.0V to +3.0V	50			V/µs	Vcc = 3.3V, R_L = 3kΩ, C_L = 150pF, Figures 18 and 19
RS-485/RS-422 (SP337EB and SP337EU) DATA RATE = 15Mbps, ONE TRANSMITTER SWITCHING						
	Maximum Data Rate	15	20		Mbps	R_{DIFF} = 54Ω, C_L = 50pF
t_{DPHL}, t_{DPLH}	Differential Output Propagation Delay Time		60	120	ns	Figures 5 and 6
t_R, t_F	Driver Rise and Fall Time		15	25	ns	Figures 5 and 6
$\lvert t_{DPHL}-t_{DPLH} \rvert$	Driver Propagation Delay Skew			10	ns	Figures 5 and 6
t_{DZH}, t_{DZL}	Driver Output Enable Time			400	ns	Figures 7, 8, 9 and 10
t_{DHZ}, t_{DLZ}	Driver Output Disable Time			400	ns	Figures 7, 8, 9 and 10
t_{PHL}, t_{PLH}	Receiver Propagation Delay		80	150	ns	Figures 11 and 12
t_{ZH}	Receiver Enable to Output High		100	200	ns	Figures 13 and 14
t_{ZL}	Receiver Enable to Output Low		100	200	ns	Figures 13 and 15
t_{HZ}	Receiver Output High to Disable		100	200	ns	Figures 13 and 16
t_{LZ}	Receiver Output Low to Disable		100	200	ns	Figures 13 and 17

UNLESS OTHERWISE NOTED: VCC = +3.3V +/-5% OR +5.0V +/-5%, C1-C4 = 0.1µF; TA = TMIN TO TMAX.
TYPICAL VALUES ARE AT VCC = 3.3V, TA = +25°C.

SYMBOL	PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
RS-485/RS-422 SHUTDOWN FEATURE APPLIES TO SP337EU ONLY						
t_{DZZV}	Shutdown to Driver Output Valid		100	400	ns	
$t_{Dshutdwn}$	Driver Time to Shutdown		100		ns	
t_{RZZV}	Shutdown to Receiver Output Valid		400	800	ns	
$t_{Rshutdwn}$	Receiver Time to Shutdown		100		ns	
ESD PROTECTION						
	ESD Protection for TX and RI Pins 3, 4, 6, 7, 15, 16, 17, 18, 24		+/-15		kV	Human Body Model
	All Other Pins		+/-2		kV	Human Body model

FIGURE 2. RS-485 DRIVER DC TEST CIRCUIT

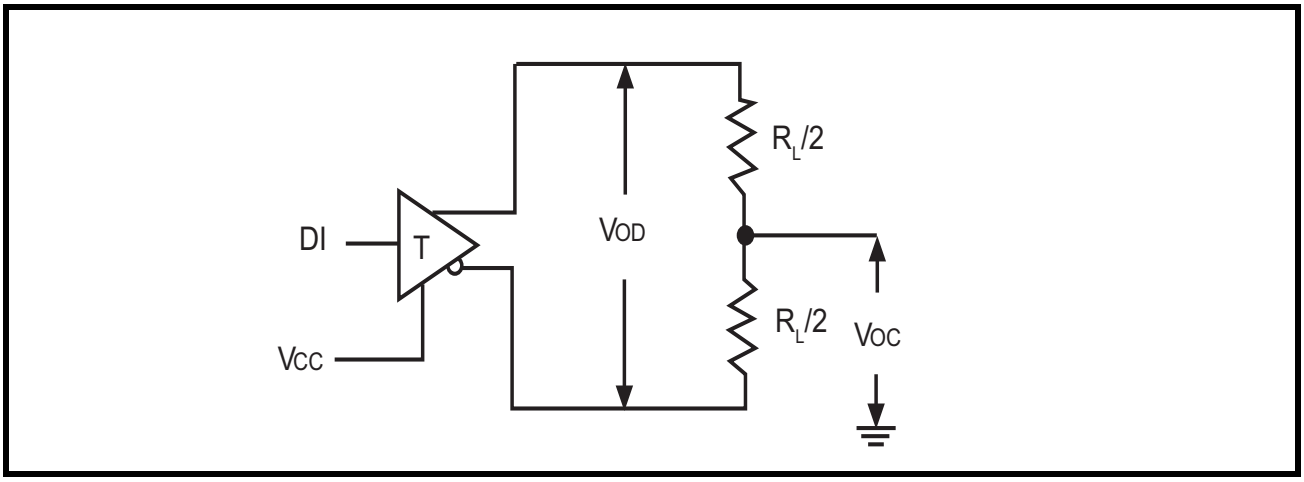


FIGURE 3. RS-485 DRIVER COMMON MODE LOAD TEST

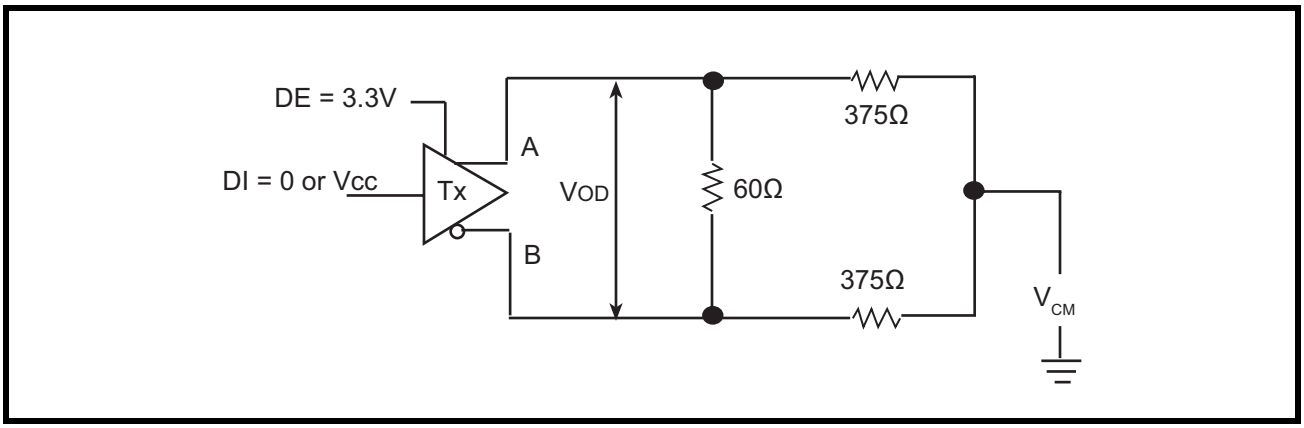


FIGURE 4. RS-485 DRIVER OUTPUT SHORT CIRCUIT TEST

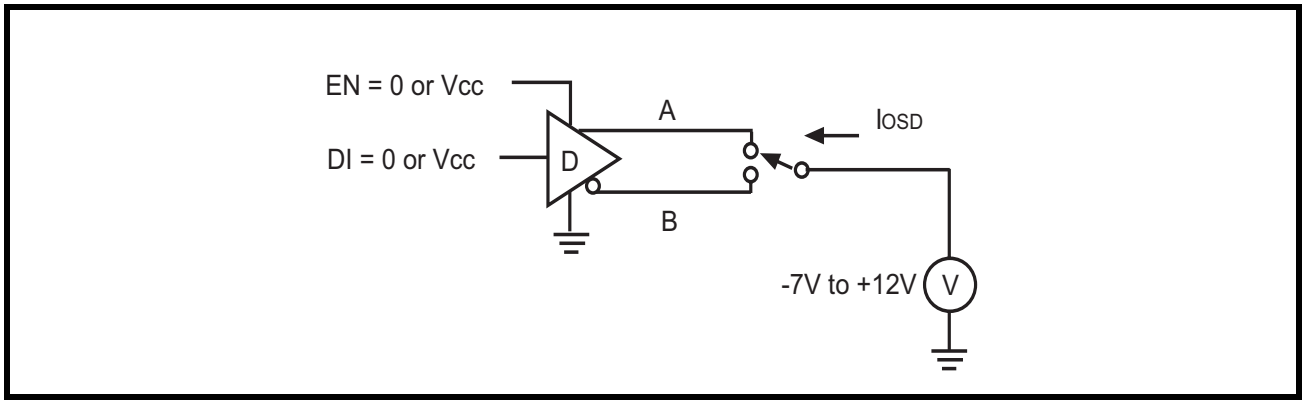


FIGURE 5. RS-485 DRIVER PROPAGATION DELAY TEST CIRCUIT

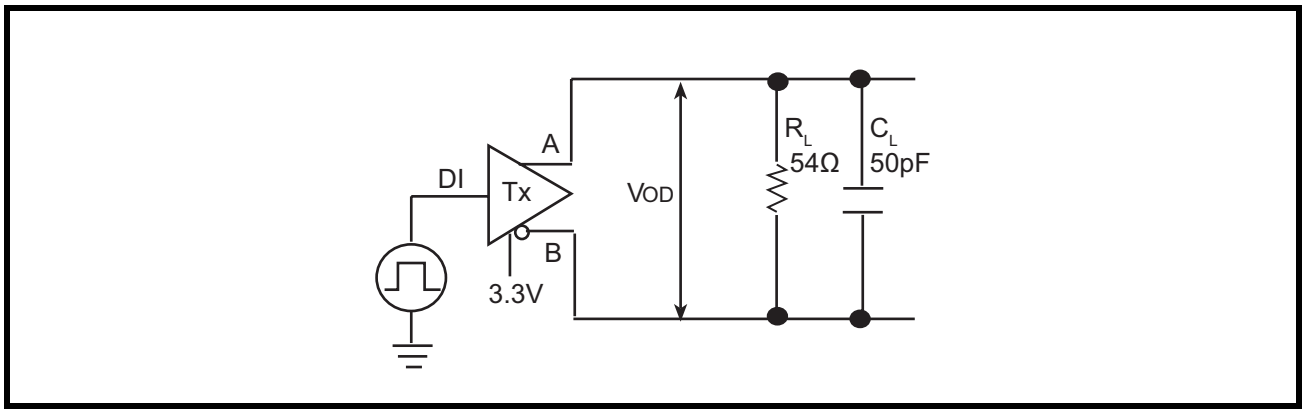


FIGURE 6. RS-485 DRIVER TIMING DIAGRAM

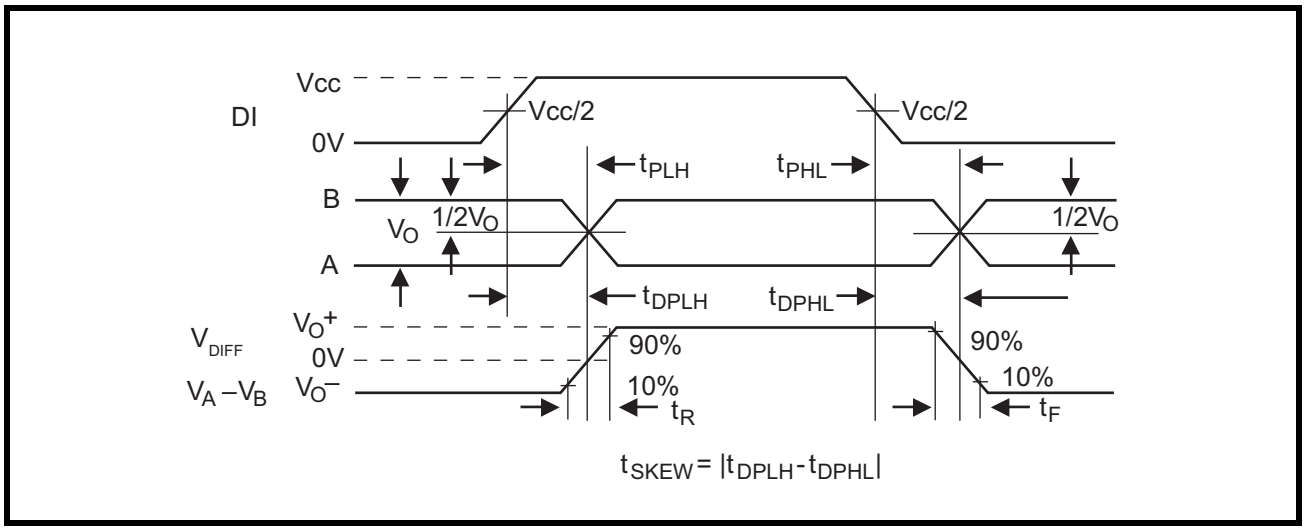


FIGURE 7. RS-485 DRIVER ENABLE AND DISABLE TEST CIRCUIT

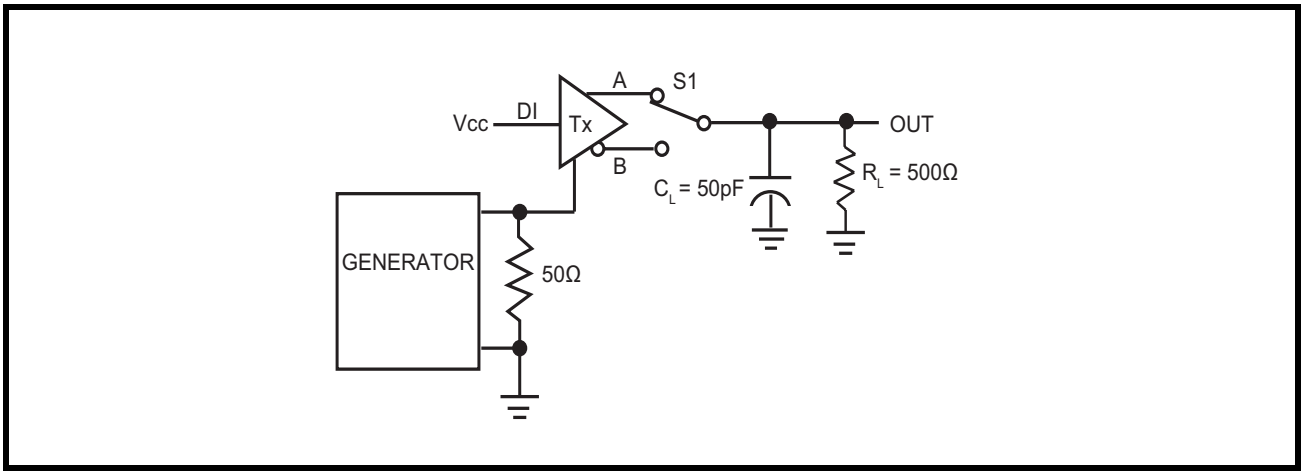


FIGURE 8. RS-485 DRIVER ENABLE AND DISABLE TIMING DIAGRAM

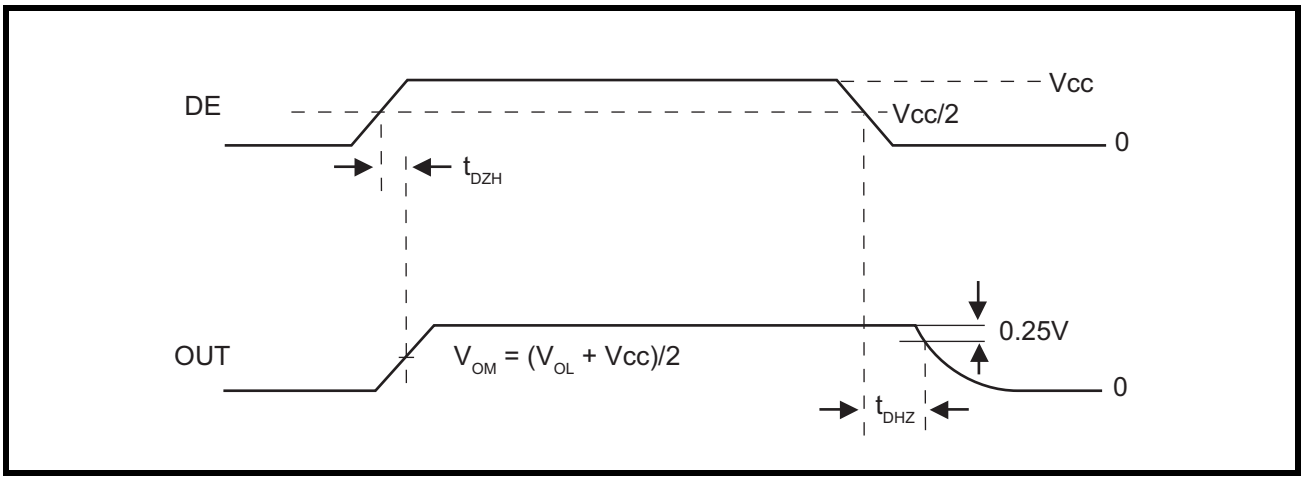


FIGURE 9. RS-485 DRIVER ENABLE AND DISABLE TEST CIRCUIT 2

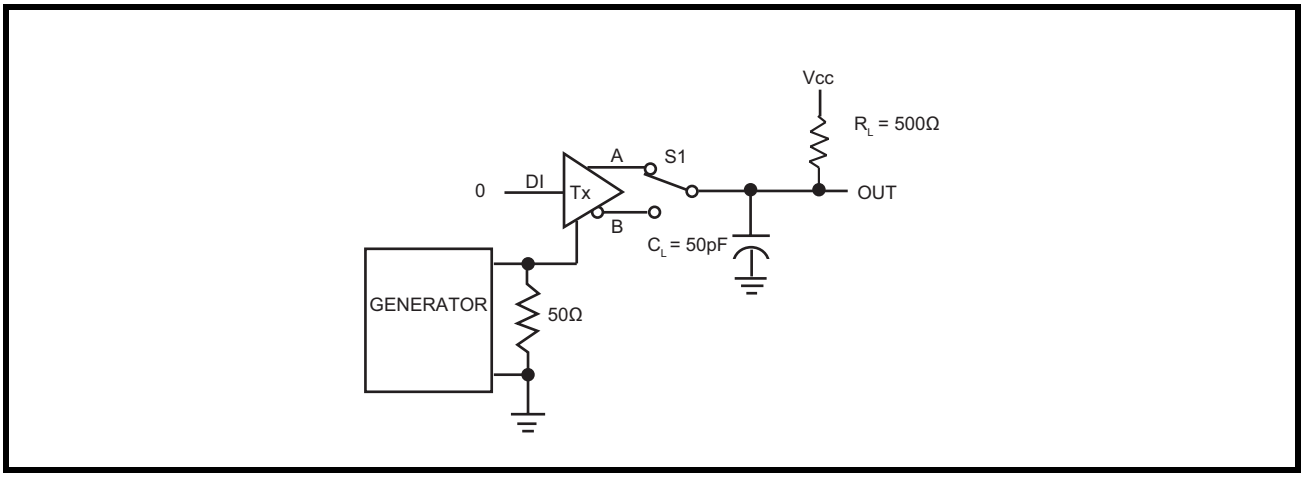


FIGURE 10. RS-485 DRIVER ENABLE AND DISABLE TIMING DIAGRAM 2

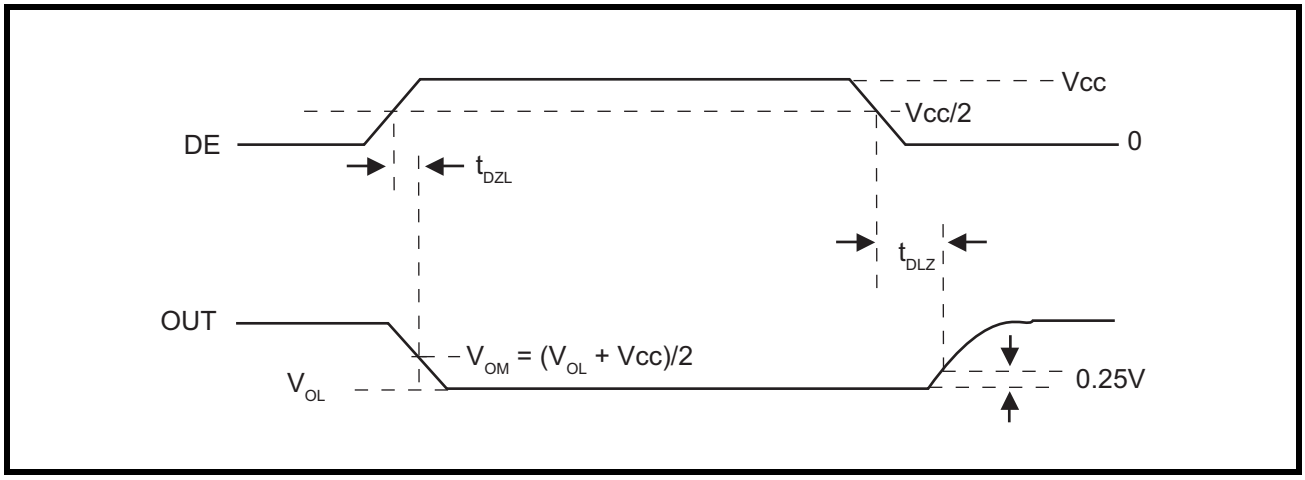


FIGURE 11. RS-485 RECEIVER PROPAGATION DELAY TEST CIRCUIT

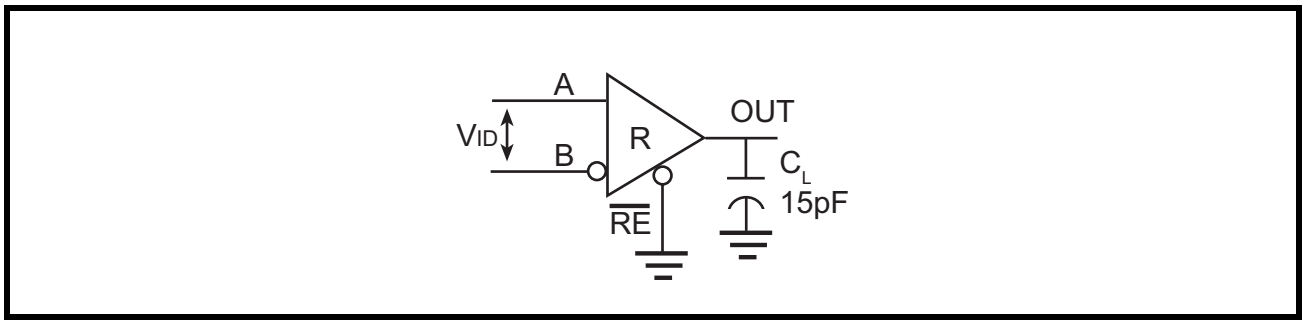


FIGURE 12. RS-485 RECEIVER PROPAGATION DELAY TIMING DIAGRAM

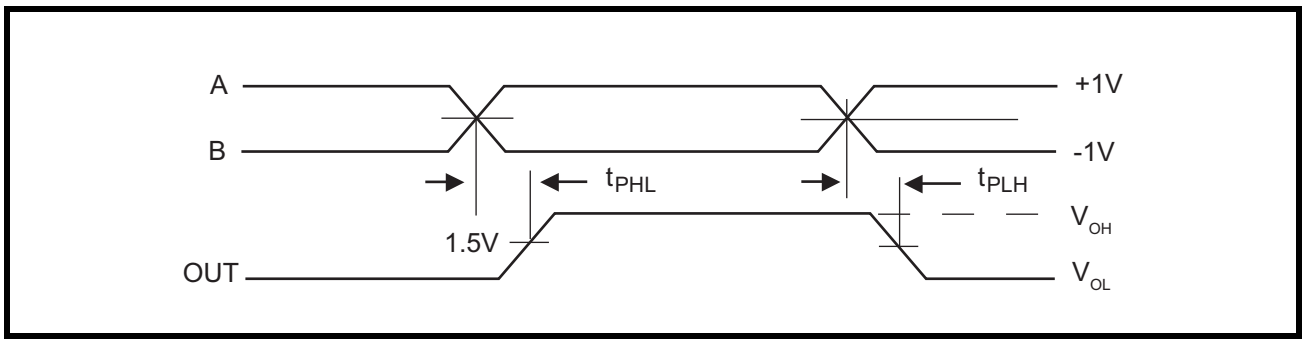


FIGURE 13. RS-485 RECEIVER ENABLE AND DISABLE TIMES TEST CIRCUIT

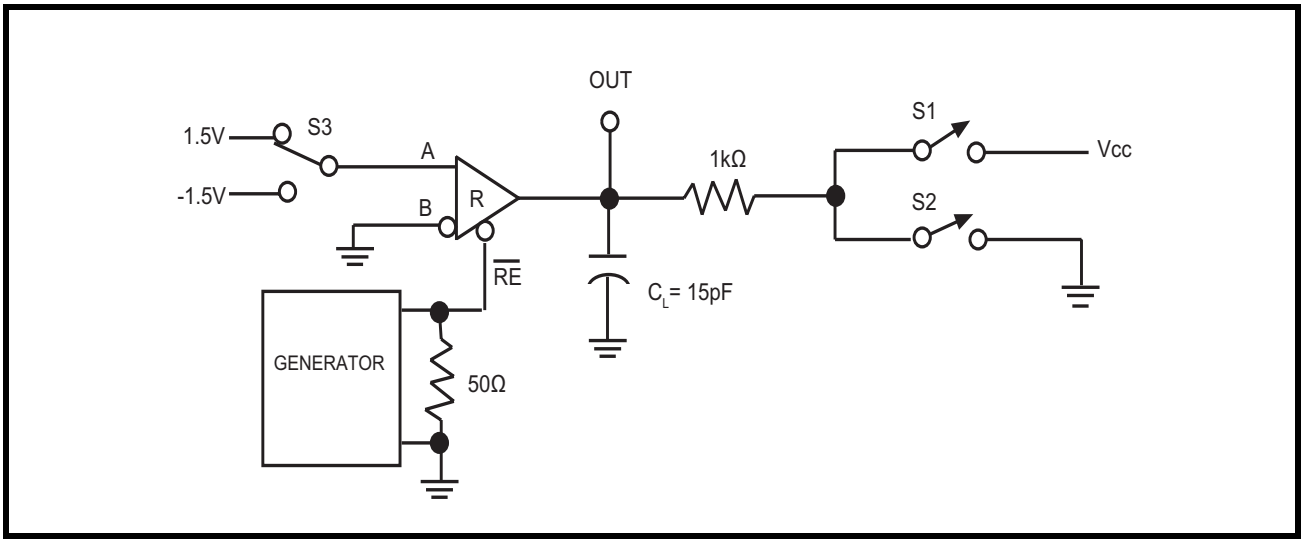


FIGURE 14. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 1

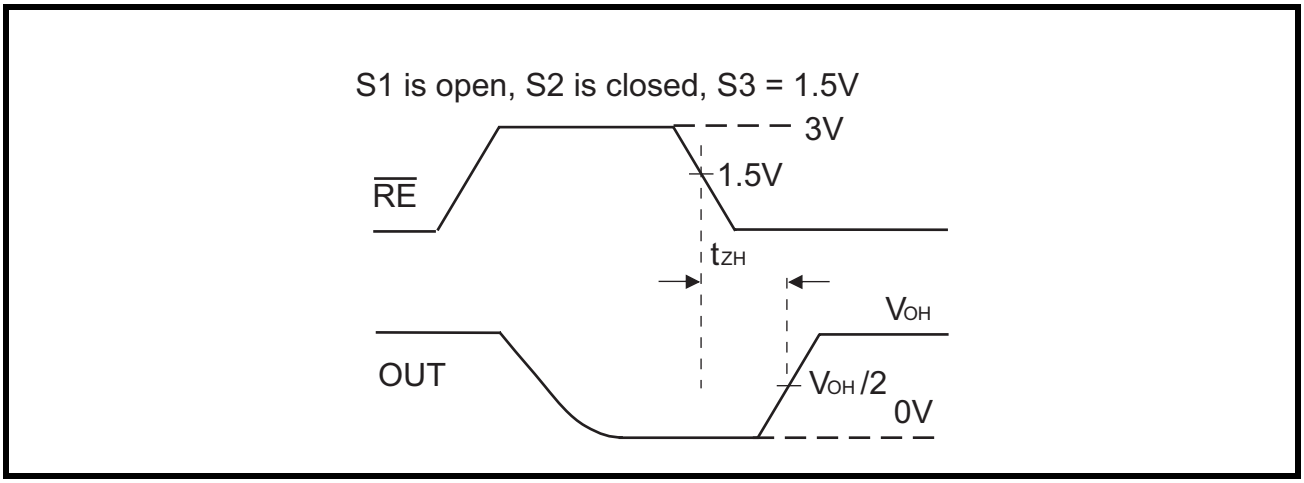


FIGURE 15. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 2

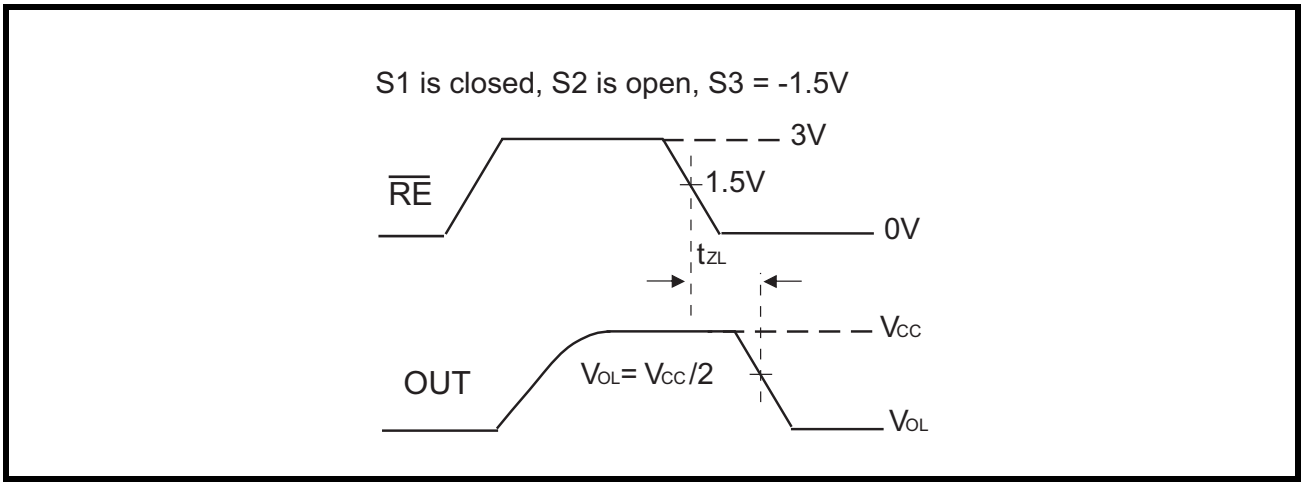


FIGURE 16. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 3

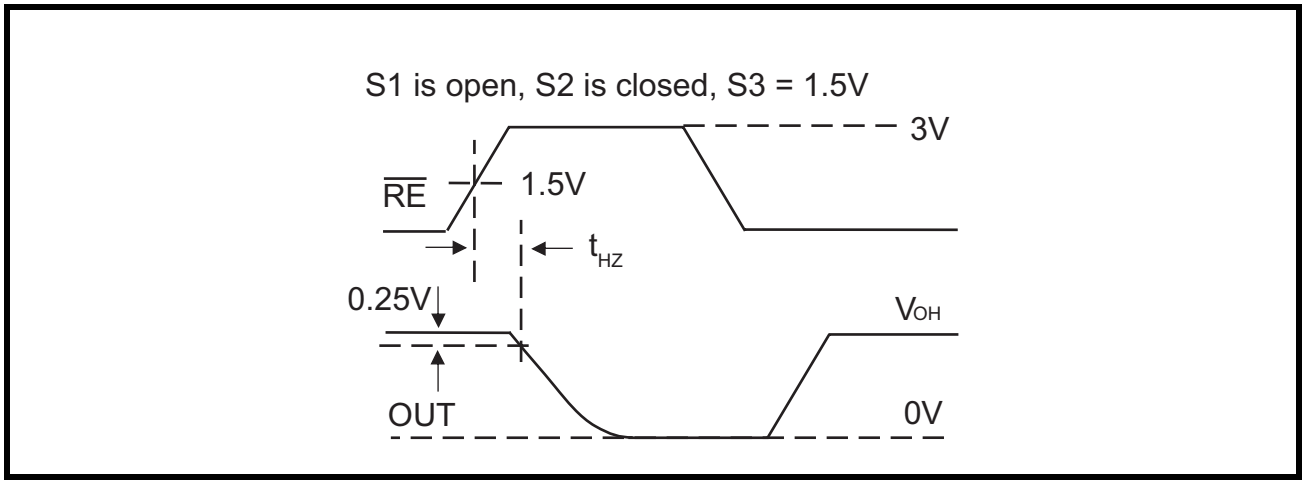


FIGURE 17. RS-485 RECEIVER ENABLE AND DISABLE TIMES TIMING DIAGRAM 4

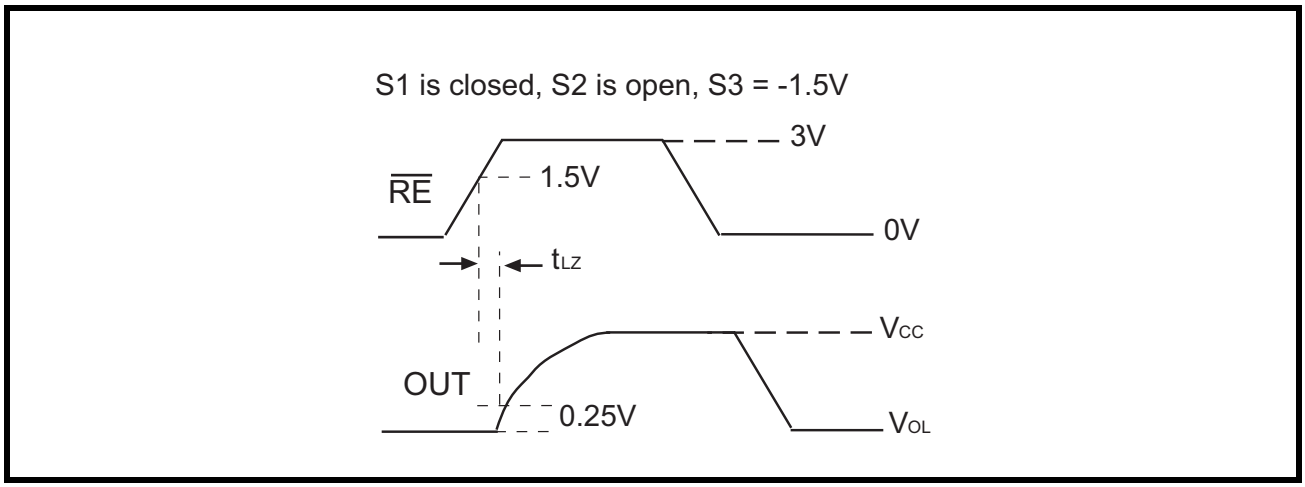


FIGURE 18. RS-232 DRIVER OUTPUT SLEW RATE TEST CIRCUIT

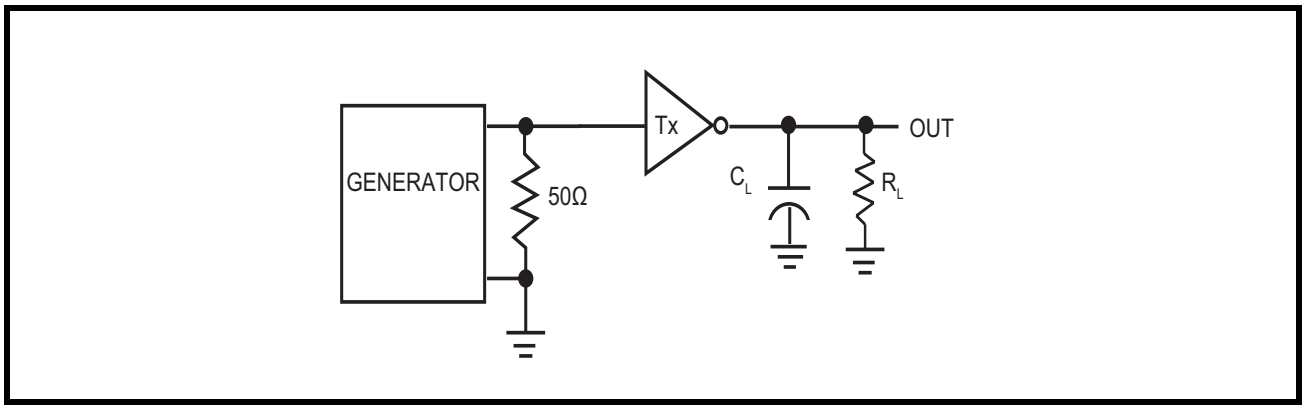


FIGURE 19. RS-232 DRIVER OUTPUT SLEW RATE TIMING DIAGRAM

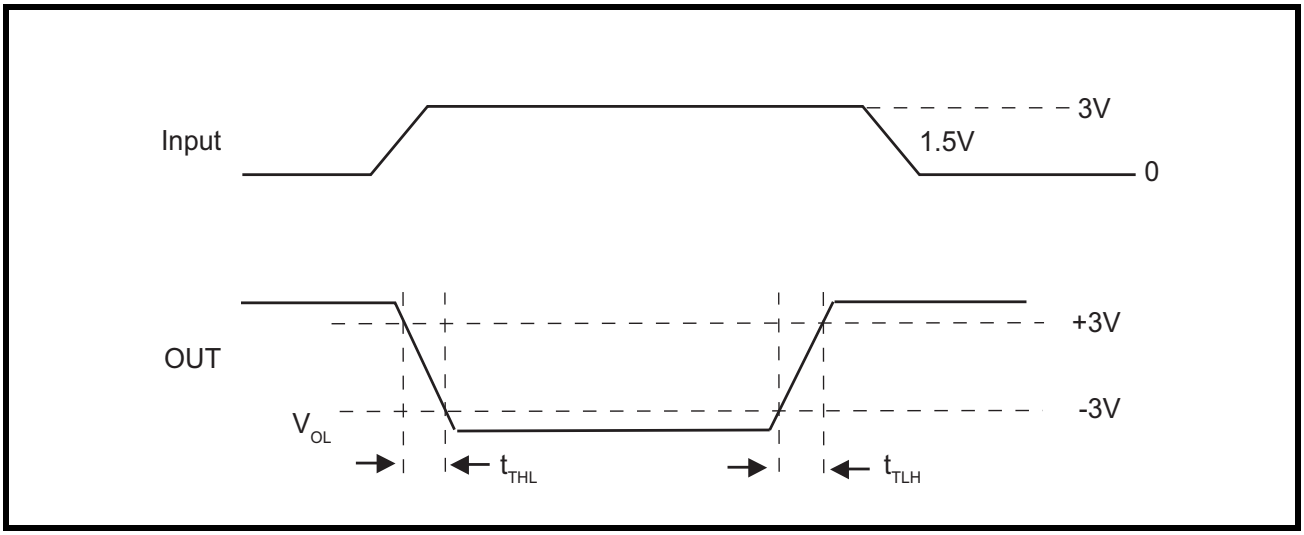


FIGURE 20. RS-232 RECEIVER PROPAGATION DELAY TEST CIRCUIT

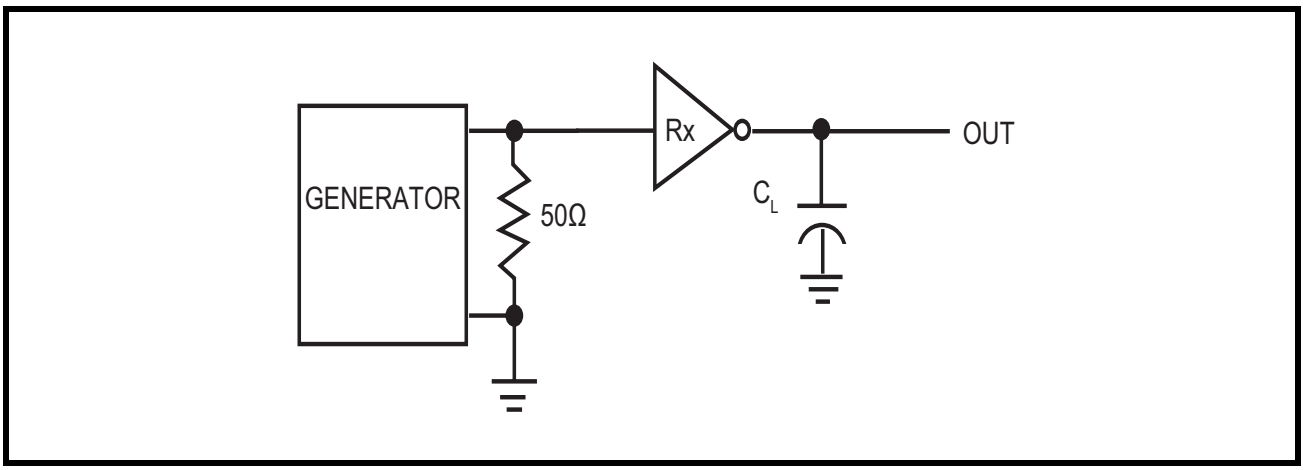
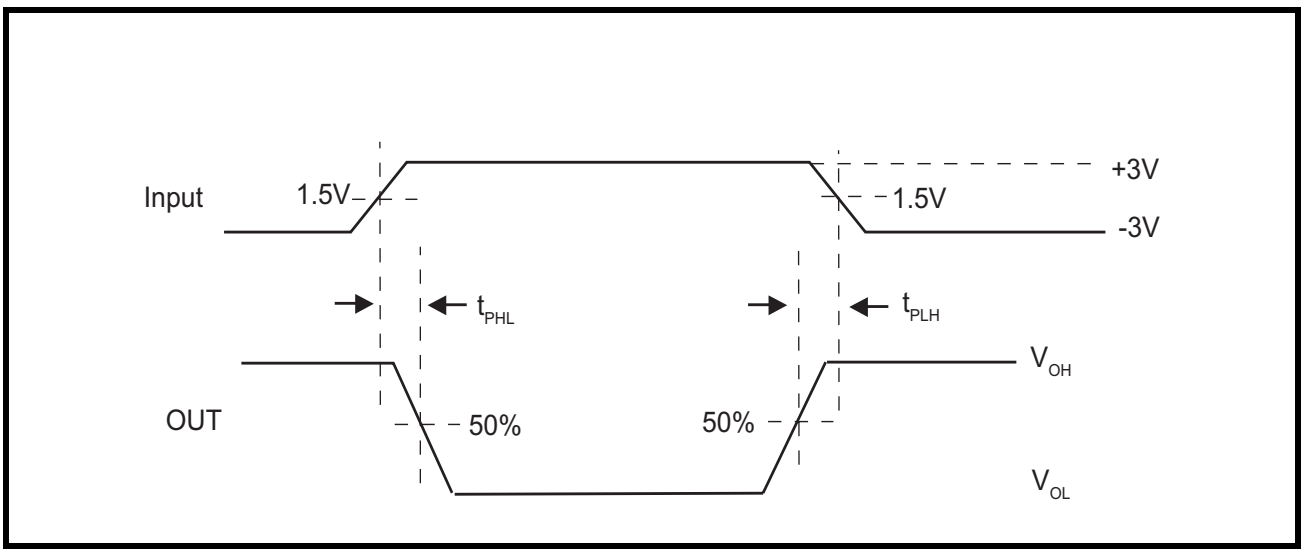


FIGURE 21. RS-232 RECEIVER PROPAGATION DELAY TIMING DIAGRAM



SP337E Mode Configuration tables

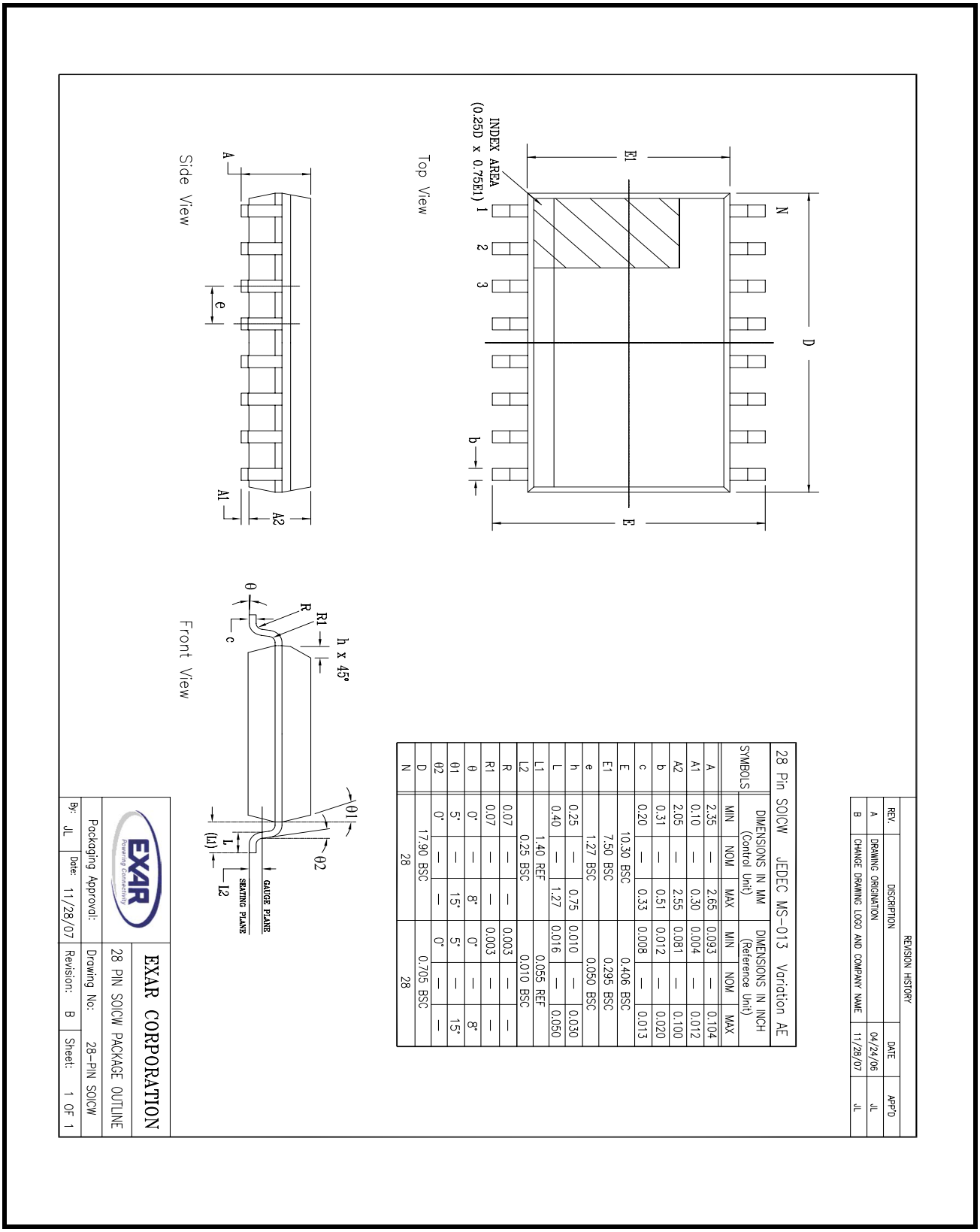
TABLE 1: SP337EB

$\overline{RS232}$/RS485	TXEN	$\overline{RXEN}$	Operation		Charge Pump	Driver and Receiver
Low	Ignored	Low	RS-232	3T/5R	ON	Receivers Enabled
Low	Ignored	High	RS-232	3T/5R	ON	Receivers Disabled (High-Z Output)
High	Low	Low	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Disabled (High-Z Output); Receivers Enabled
High	High	High	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Enabled; Receivers Disabled (High-Z Output)
High	Low	High	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Disabled (High Z output); Receivers Disabled (High Z output)
High	High	Low	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Enabled; Receivers Enabled

TABLE 2: SP337EU

$\overline{RS232}$/RS485	TXEN	$\overline{RXEN}$	Operation		Charge Pump	Driver and Receiver
Low	Ignored	Low	RS-232	3T/5R	ON	Receivers Enabled
Low	Ignored	High	RS-232	3T/5R	ON	Receivers Disabled (High-Z Output)
High	Low	Low	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Disabled (High-Z Output); Receivers Enabled
High	High	High	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Enabled; Receivers Disabled (High-Z Output)
High	Low	High	RS-485/422 Full-Duplex	2T/2R	OFF (Shutdown)	Drivers Disabled (High Z output); Receivers Disabled (High Z output)
High	High	Low	RS-485/422 Full-Duplex	2T/2R	ON	Drivers Enabled; Receivers Enabled

FIGURE 22. 28 PIN WSOIC PACKAGE OUTLINE DRAWING



REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	04/24/06	JL
B	CHANGE DRAWING LOGO AND COMPANY NAME	11/28/07	JL

28 Pin SOICW JEDEC MS-013 Variation AE

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	17.90 BSC			0.705 BSC		
N	28			28		

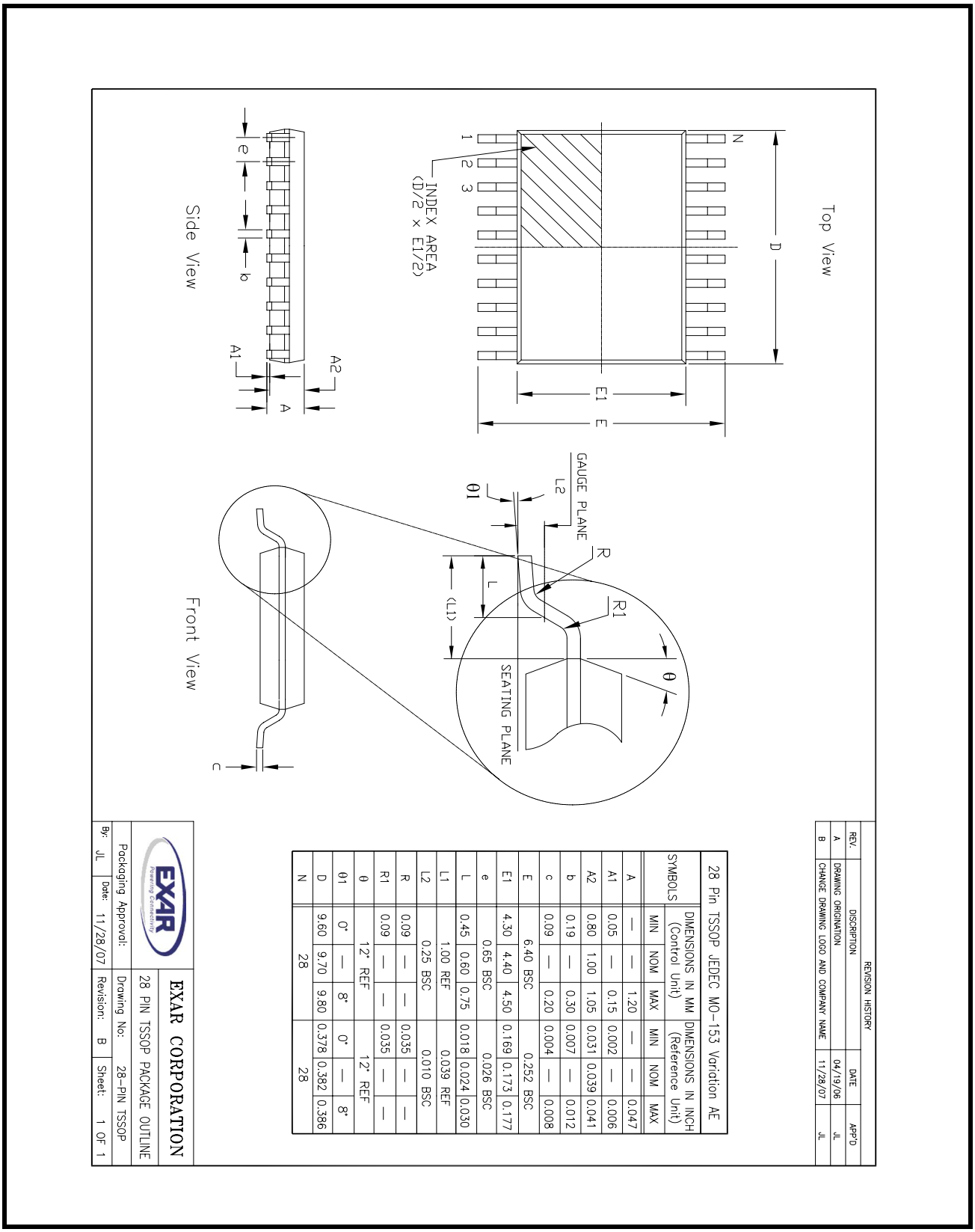
EXAR CORPORATION

28 PIN SOICW PACKAGE OUTLINE

By:	Date:	Revision:	Sheet:
JL	11/28/07	B	1 OF 1

Packaging Approval: Drawing No: 28-PIN SOICW

FIGURE 23. 28 PIN TSSOP PACKAGE OUTLINE DRAWING



REVISION HISTORY

DATE	REVISION	DESCRIPTION
December 2010	1.0.0	Production Release.
December 2010	1.0.1	Update ESD Information.
March 2011	1.0.2	Correct Figure 1 RS-485 driver type error.

NOTICE

EXAR Corporation reserves the right to make changes to the products contained in this publication in order to improve design, performance or reliability. EXAR Corporation assumes no responsibility for the use of any circuits described herein, conveys no license under any patent or other right, and makes no representation that the circuits are free of patent infringement. Charts and schedules contained here in are only for illustration purposes and may vary depending upon a user's specific application. While the information in this publication has been carefully checked; no responsibility, however, is assumed for inaccuracies.

EXAR Corporation does not recommend the use of any of its products in life support applications where the failure or malfunction of the product can reasonably be expected to cause failure of the life support system or to significantly affect its safety or effectiveness. Products are not authorized for use in such applications unless EXAR Corporation receives, in writing, assurances to its satisfaction that: (a) the risk of injury or damage has been minimized; (b) the user assumes all such risks; (c) potential liability of EXAR Corporation is adequately protected under the circumstances.

Datasheet March 2011.

For technical support please email Exar's Serial Technical Support group at: serialtechsupport@exar.com.